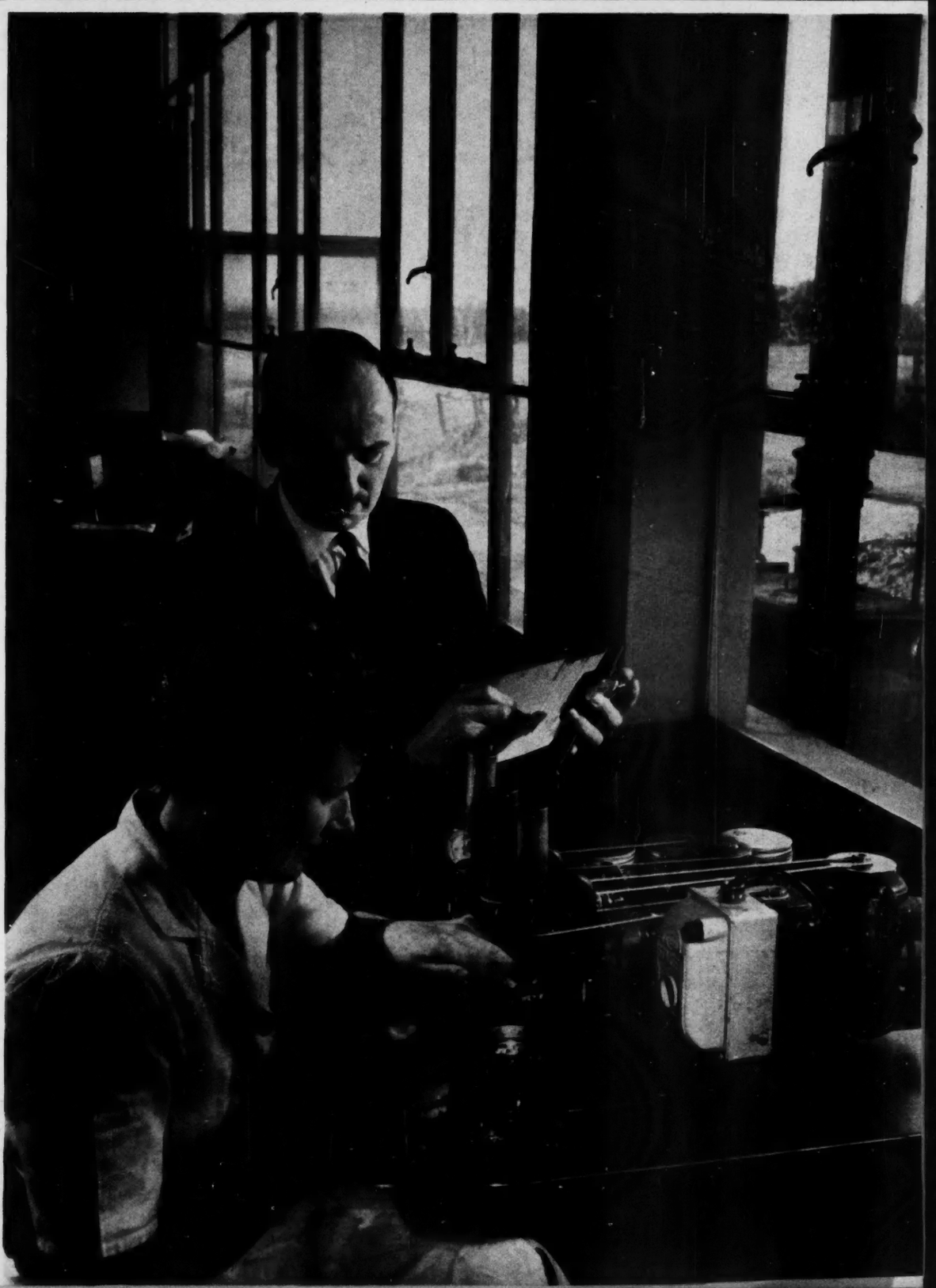
ENGINEERING

Outlook 1960



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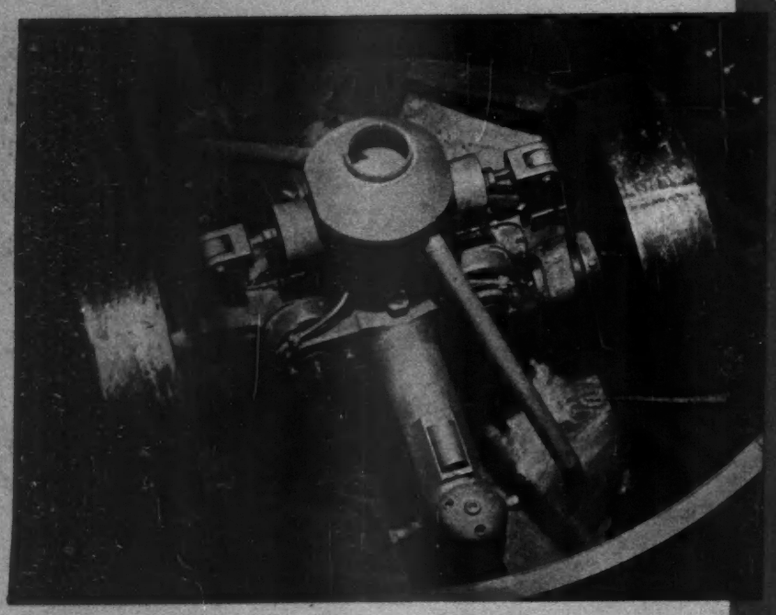

AUGUST-SIMPSON MIX-MULLERS

MADE BY AUGUSTS LIMITED OF HALIFAX

These machines have been developed for mulling foundry sand and large quantities of other dry, semi-dry and pasty materials in the ceramic, chemical, food and process industries.

Mix-Mullers, it is claimed, give an increased muller pressure with a minimum of muller inertia, thus instead of using heavy mullers and relying upon gravity, light spring-loaded mullers are used. This makes it possible to give a close control of the muller pressure.

These machines are manufactured with capacities of from 25 to 4,000 lb. per batch according to the type and throughput of materials being used. It is said that the material to be mixed is subjected to a more violent agitation, thereby reducing the tendency to form 'muller cake'.

It will be understood that the sealing arrangements for anti-friction bearings in a machine of this kind present their own problems, and the illustrations will show the care with which the Timken tapered-roller bearings have been installed.

British Timken, Duston, Northampton, Division of The Timken Roller Bearing Company. Timken bearings manufactured in England, Australia, Canada, France and U.S.A.

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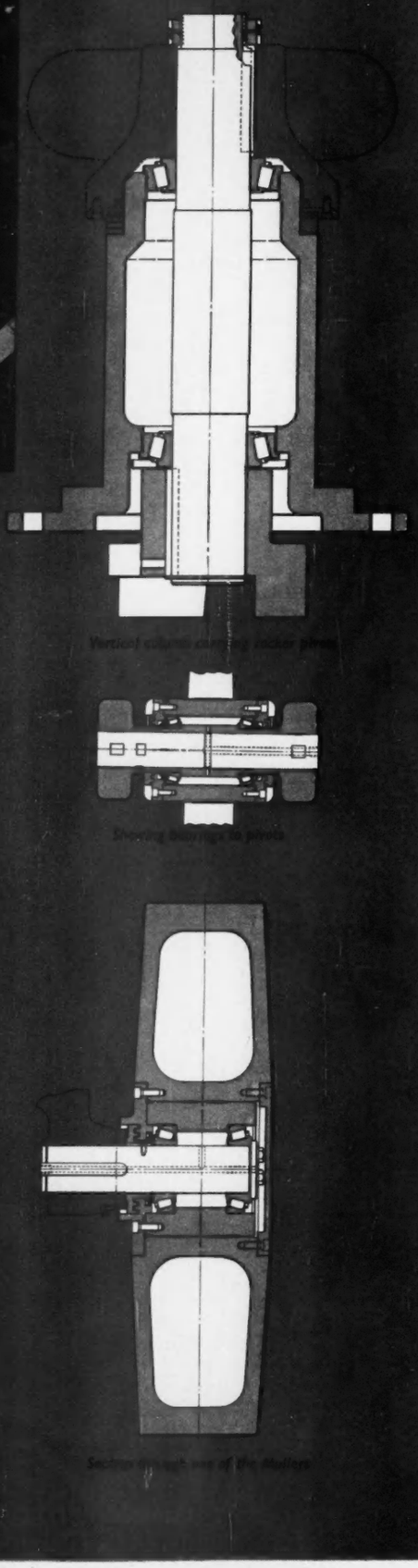
REGISTERED TRADE-MARK
tapered roller bearings



International NU-SWIFT News

No. 1

HAVE YOU MET THESE PEOPLE?

1. The new 16-floor skyscraper in BASLE, Switzerland built, and occupied by GEIGY, the world-famous chemical concern, has been equipped with Nu-Swift extinguishers.

2. Old-fashioned chemical extinguishers in the SHELL-MEX Building, in the STRAND, LONDON, largest office building in the Commonwealth, have been superseded by reliable Nu-Swift equipment. Built in 1933, the 8,008,462 cubic feet of this giant edifice, which boasts 16 lifts, 6 oil-fired boilers and 22 miles of water pipes, are now protected by a total of 261 Nu-Swift extinguishers.

3. MONTEGO BAY AIRPORT on the North Coast of Jamaica, well-known to sun-hungry socialites in U.S.A. and Britain, is now safeguarded by Nu-Swift. So is the exclusive TOWER ISLE HOTEL.

4. In gay VIENNA, 30 break-down vehicles belonging to the TOURING CLUB OF AUSTRIA (similar to the British A.A. service) have recently been equipped with Nu-Swift. Another 31 vehicles in GRAZ have been similarly protected

5. In STOCKHOLM, beautiful capital of Sweden, a rush order for 1½ tons of extinguishers was recently executed by Nu-Swift sales concessionaires in six hours. The number of extinguishers required was 60. SKF, ASEA and STORA KOPPARBERGS BERGSLAGS A/B (the oldest industrial undertaking in the world), are among other industrial giants in fast moving Sweden, who have standardised on reliable Nu-Swift Dry Powder Extinguishers.

6. If overtaken by the LAKE POLICE while speeding on the 20-mile long LAKE ZURICH, you will find their patrol boats equipped with Elland-made Nu-Swift Dry Powder Extinguishers, Model 1604. Ashore this also applies to the police cars and garages of the City and Kanton of busy and prosperous ZURICH.

7. Direct rail connections link COPENHAGEN with Rome, Paris, Vienna, Venice, etc. THE DANISH STATE RAILWAYS have now equipped all international coaches starting from the up-to-date capital of Denmark, with Nu-Swift.

8. MR. HUGH DALTON, M.P., Chancellor of the Exchequer in the post-war Labour Government (1945-47), is the latest prominent politician to equip his home with Nu-Swift.

9. After exhaustive tests, extending over several years, the AUSTRALIAN ARMY have satisfied themselves that Nu-Swift Dry Powder Extinguisher, Model 1604, meets their exacting requirements. The first orders have been placed.

10. More than 50 per cent. of all new NORWEGIAN vessels, mainly TANKERS, are protected by Nu-Swift.

11. Prince FAROUK, now a citizen of Monaco, but once King of EGYPT, one day when shooting in the desert near Cairo, saw his car ablaze. Fire was put out by a local Nu-Swift enthusiast. Result: The King had all his palaces and his yacht protected by Nu-Swift.

12. The underground aeroplane factories of SAAB (SVENSKA AEROPLANE A/B) Linköping, Sweden, are protected by Nu-Swift. So are the naval vessels in the ATOM-BOMB-PROOF UNDERGROUND HARBOUR near Stockholm, built into the mountain by the cautious Swedes.

13. In far-off FIJI, where cannibalism was rife within living memory, the recently constructed BROADCASTING STATION is protected against fire by Nu-Swift. So is the new AUTOMATIC TELEPHONE EXCHANGE.

14. An animated correspondence with G. BERNARD SHAW resulted in 1944 from an enquiry by the ever-alert but critical sage. Asked by Shaw why, in our letter of reply, no prices were quoted, a cheeky Nu-Swift clerk retorted that "We thought you wanted to protect your life, not your purse. Does price matter when your life is at stake?" G.B.S. rose to the bait by replying: "Please treat me as a prospective customer, not as a back-chat comedian."

15. SWISS FEDERAL RAILWAYS, one of the most efficient and modern railway systems in the world, have placed their first orders for Nu-Swift extinguishers.

16. Mr. W. J. SCOTT, Q.C., FIRE MARSHAL OF THE PROVINCE OF ONTARIO, during a recent lightning trip to Europe, as Dominion Government NATO delegate, included Elland in his itinerary. On his return, having also called at London, Paris, Rome and Madrid, he stated that the visit to Nu-Swift Factory remained the highlight of his European tour, and caused orders to be placed for sample and demonstration extinguishers for the new Ontario Fire Service College at GRAVENHURST, 80 miles from TORONTO.

HAVE YOU BEEN TO THESE PLACES?

17. Since THE SUDAN gained her independence, the authorities have decided to standardize on Nu-Swift. The first orders have arrived from Khartoum.

18. In KUWAIT, fabulously wealthy Arabian oil-well state on the Persian Gulf, police and army cars are now all protected by Nu-Swift.

19. The SOUTH AFRICAN ELECTRICITY SUPPLY COMMISSION have decided to place Nu-Swift Dry Powder Extinguisher, Model 1604, on all their break-down and service vehicles. The first orders have been placed.

20. In NIGERIA, Africa, which is shortly expected to achieve independence, TRAINS AND HOSPITALS are equipped with Nu-Swift. Climate is hot and humid.

21. BRITISH EXPORTS of fire extinguishers are the highest in the world. Total value of NU-SWIFT exports is increasing continuously. Last year they amounted to NEARLY ONE-THIRD OF THE BRITISH TOTAL.

22. In arctic SPITZBERGEN (Norwegian: SVALBARD), divided by an invisible iron curtain, but where Norwegian and Russian workers fraternise, the NORWEGIAN COLLIERIES of STORE NORDISKE SPITSBERGEN KULKOMPAGNI are protected by Nu-Swift.

23. THE ROYAL CANADIAN NAVY, which in 1947 standardized on the Nu-Swift Universal Water/CO_2 Extinguisher, has placed further orders.

24. HAILE SELASSIE, H.I.M. of ETHIOPIA, is reported to take a keen interest in fire extinguishers. Nu-Swift has been approved and the first consignments have been sent to ADDIS ABABA.

Wherever you are, in Britain or abroad,

you will be wise to find out

how NU-SWIFT can protect you better

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NICKEL ALLOY STEELS

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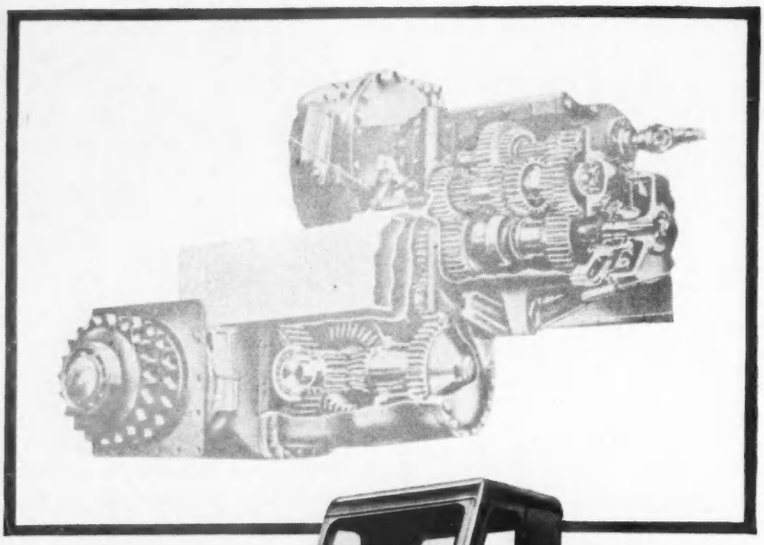

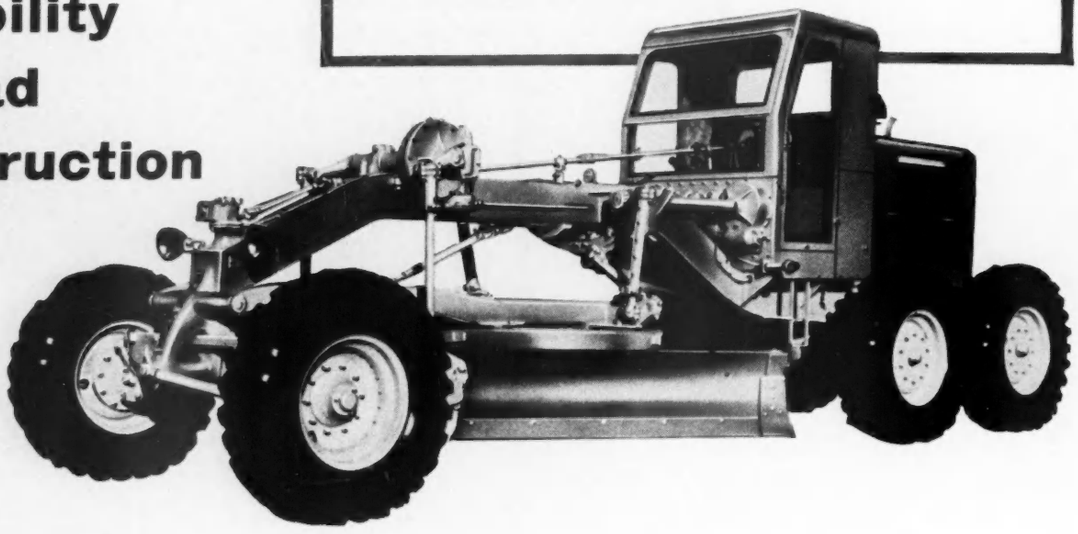

The power which operates and controls the Blaw Knox B.K. 12 Grader is transmitted through components of nickel alloy steels, notably the stub axles, track rods and half shafts, which are made from EN 25 2½ per cent nickel-chromium-molybdenum forged steel. This and other nickel alloy steels are used for such components as the main and subsidiary gears, pinions and pins which transmit the drive from the power unit and need good resistance to both fatigue and impact.

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EN25

These illustrate its strength and toughness in massive sections.

SIZE	HEAT TREATMENT	YIELD STRESS t.s.i.	MAXIMUM STRESS t.s.i.	ELONGATION per cent	IZOD ft. lb.
2½" dia.	Oil quenched 830°C. tempered 590°C.	75·2	78·8	17	44
2½" dia.	Oil quenched 830°C. tempered 650°C.	58·8	63·6	21·5	68
4" dia.	Oil quenched 830°C. tempered 650°C.	56·2	61·8	21	69
6" dia.	Oil quenched 830°C. tempered 650°C.	55·4	61·5	22	63

By utilising the better properties obtainable in more highly alloyed nickel alloy steels, dimensions can be reduced, lighter constructions produced, distortion through heat treatment minimised and reliability and economy achieved.

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1 January 1960

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ENGINEERING

PUBLISHED EVERY FRIDAY

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Time study to prove the value of an arm rest to the operator drilling holes in a watch bottom plate. (*Nurnberg photograph for* ENGINEERING.)

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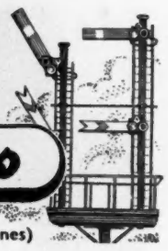

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Applications, three copies, stating age, details of qualifications, and experience, publications, research work in progress and completed, and an outline of the proposed field of research, together with the names of two referees, should be received not later than 13th February, 1960, by the REGISTRAR, from whom further particulars may be obtained. (Candidates overseas who find it more convenient to do so may send one copy only by air-mail.) A 941

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TENDERS

N.A.T.O. COMMON INFRASTRUCTURE
SLICES VII AND VIII
NAVAL BASE INSTALLATIONS

Final Notice is hereby given that International Competitive Bids will be invited on or about 17th February, 1960, for the

SUPPLY AND INSTALLATION OF THE BOILER PLANT AND ASSOCIATED EQUIPMENT for a F.O.L. Storage Depot to be constructed in the Loch Striven area of Scotland.

2. The approximate total value of the works is £60,000 and the contract will comprise of the supply and installation of:—

3 No. 13,000 lb./hour each Economic type Oil-fired Boilers, complete with Superheaters and full ancillary equipment including Fuel Oil System, Feeder Water System, Water Treatment, De Superheater, Induced Draught Fans, Station Pipe Work, etc.

3. The work will be carried out as one contract which will be undertaken as a sub-contract within the framework of the Main Contract for the construction of the depot. A Final Notice in respect of the main construction contract has already been published.

4. It should be noted that the importation of labour from sources outside the United Kingdom may be subject to restriction and that permission could, in any case, only be given on an undertaking that the Contractor would pay rates of wages and absence hours and conditions of labour not less favourable than those established for U.K. labour for the trade or industry in the same area.

5. The closing date for the receipt of bids will be 13th April, 1960.

6. Firms wishing to be invited to bid must formally notify their desire by application to the address below by 13th January, 1960.

7. Within one week of the closing date for the receipt of applications to bid, firms wishing to be invited must forward the following information:—

(i) Statement of financial resources and evidence of financial stability.

(ii) Details of recent major contracts completed for work of a comparable nature, including an indication of the value of each.

8. Enquiries regarding bidding should be addressed to:—

CIVIL ENGINEER-IN-CHIEF,
ADMIRALTY,
CHAMBERLAIN WAY,
PINNER, MIDDLESEX, ENGLAND,

quoting reference C.E. in C./INFRA/9 (Sub-Contract Boilers). A 937

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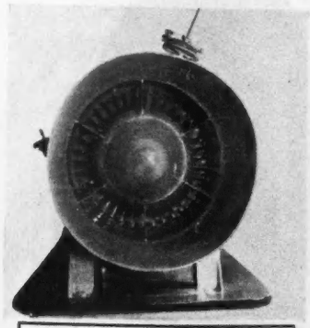

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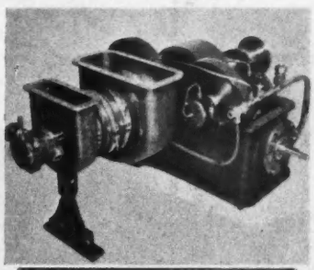

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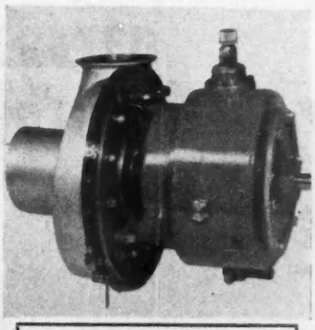

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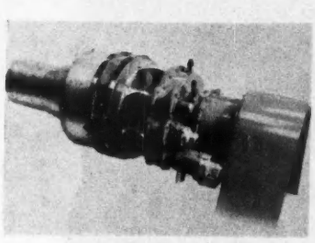

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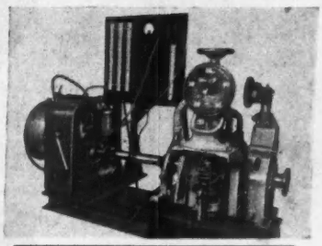

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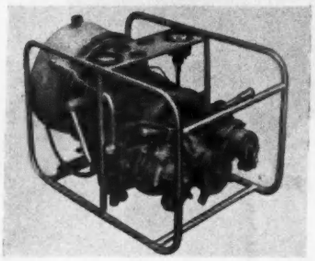

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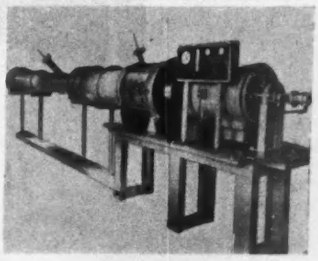

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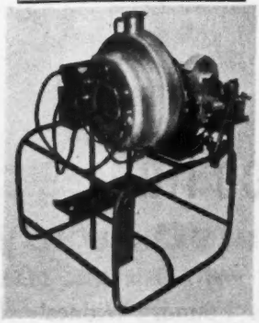

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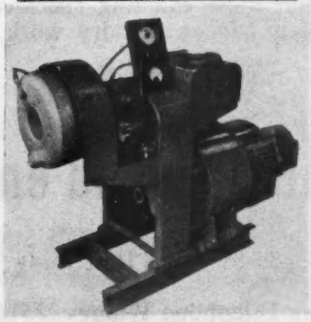

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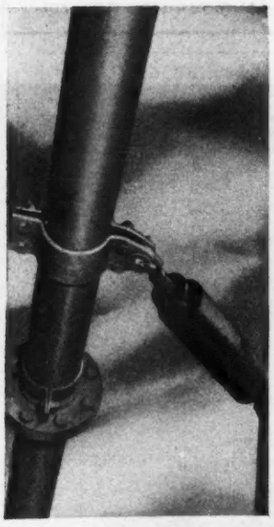

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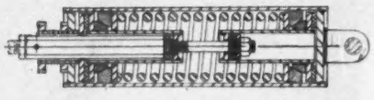

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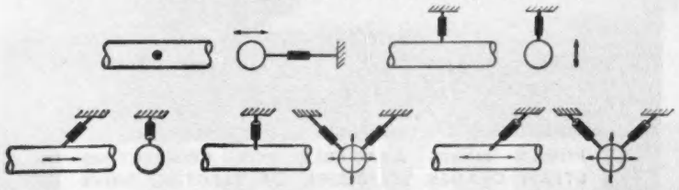

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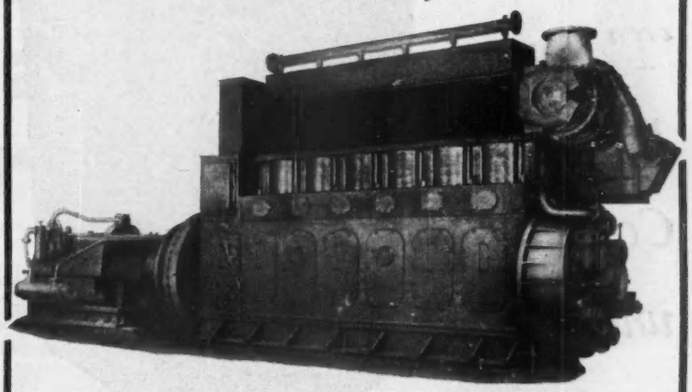

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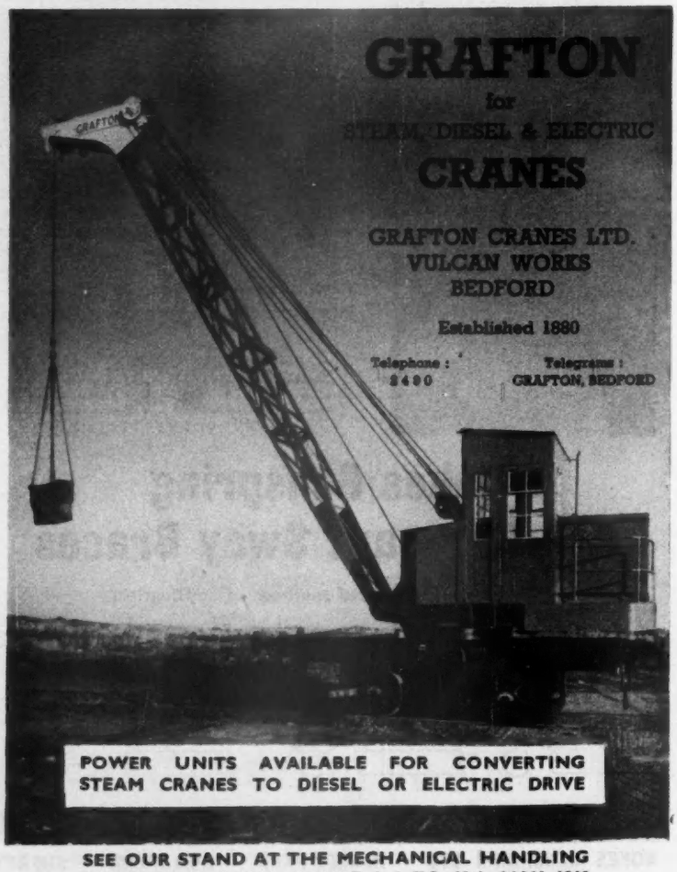

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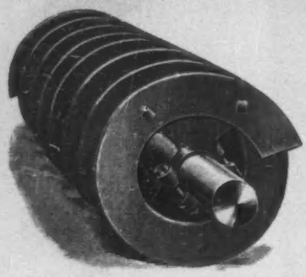

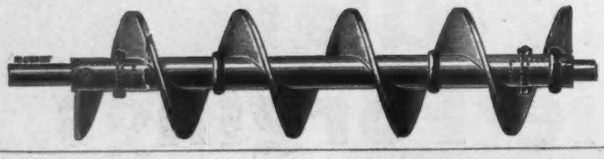

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This installation for the Tunnel Portland Cement Company, involved the manufacturing and laying of rail and crane tracks along the new jetty and joining up to existing tracks on the old jetty. The tracks are 75 lb. F.B.B.S. 'R' and 98 lb. F.B.B. Railways section.

The combination joining the new and old jetties to the main access tracks, is a treble junction and Goliath crane track comprising three turnouts, three diamond crossings and thirteen crane crossings, all prefabricated and laid down as a unit at our Works to ensure the minimum disruption to traffic. In addition, six throughroads were manufactured and installed as well as 1,053 yards of straight and curved crane and rail track, most of the crane track angle guarded.

This is yet another example of Summerson's resources and 120 years' experience in the design, manufacture and laying of railway sidings.

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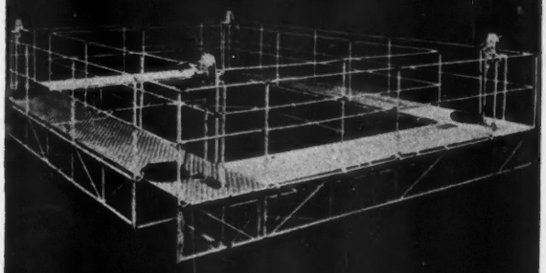
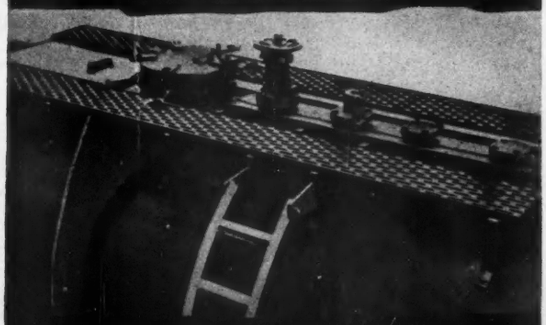
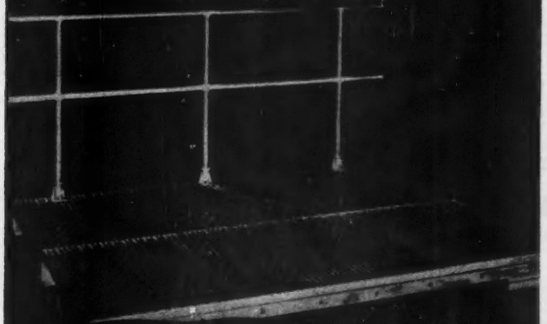
Alaflor installed in Radio Chemical Laboratories at the National Chemical Laboratory, Middlesex.



Alaflor suspended staging for inside boilers, as used by Sterling Safway Scaffolding, Jarrow.



Alaflor platforms supplied to Charles Roberts & Company Ltd., Wakefield, for Fisons Limited tank wagons.



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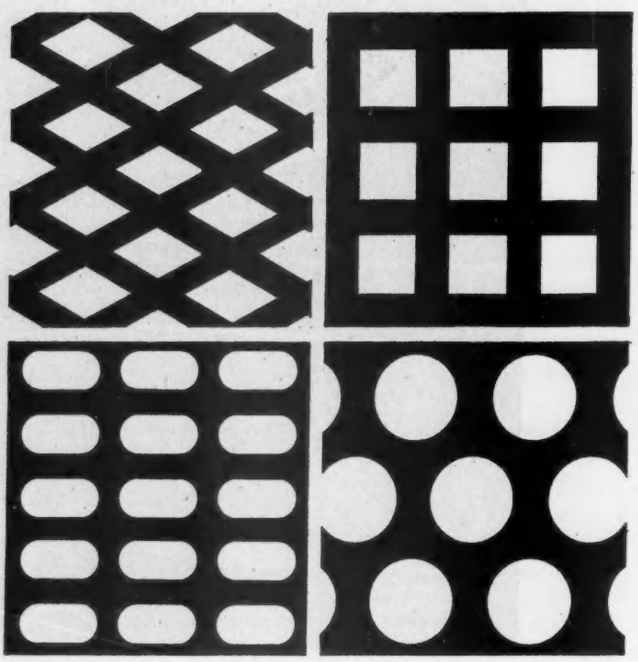

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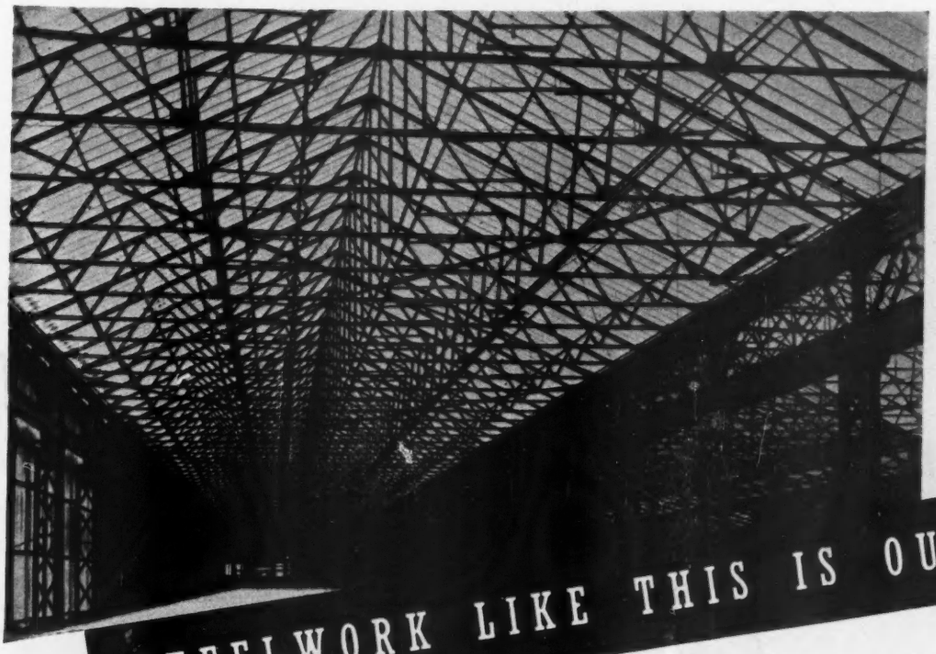

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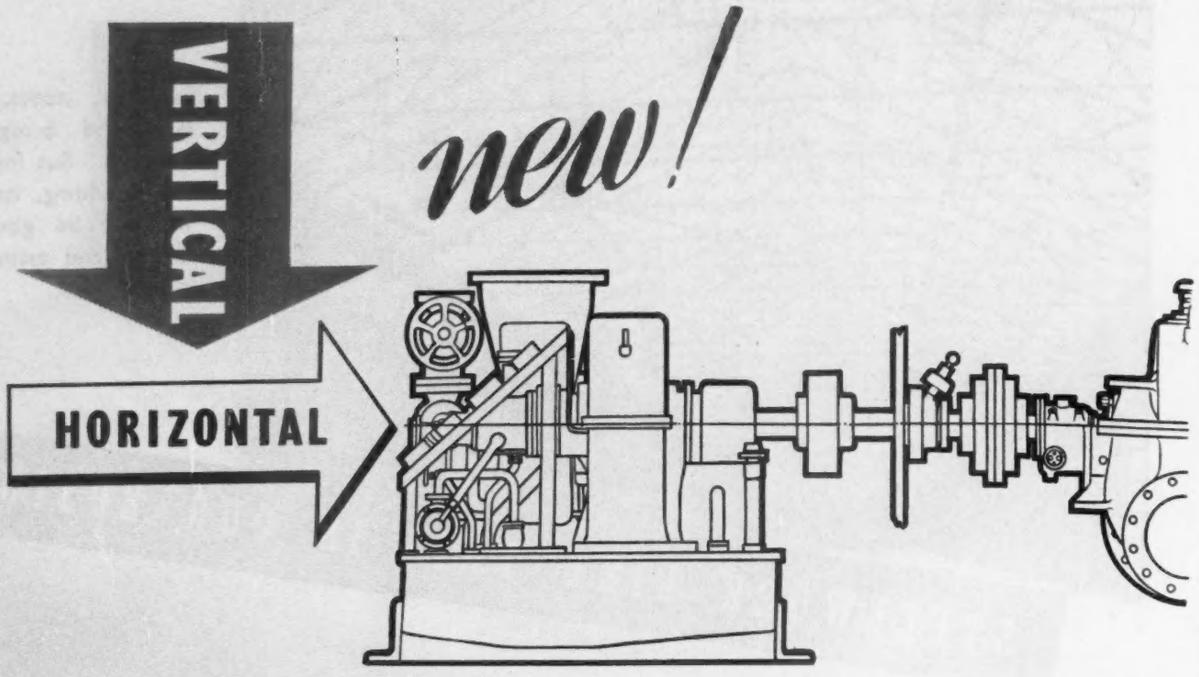

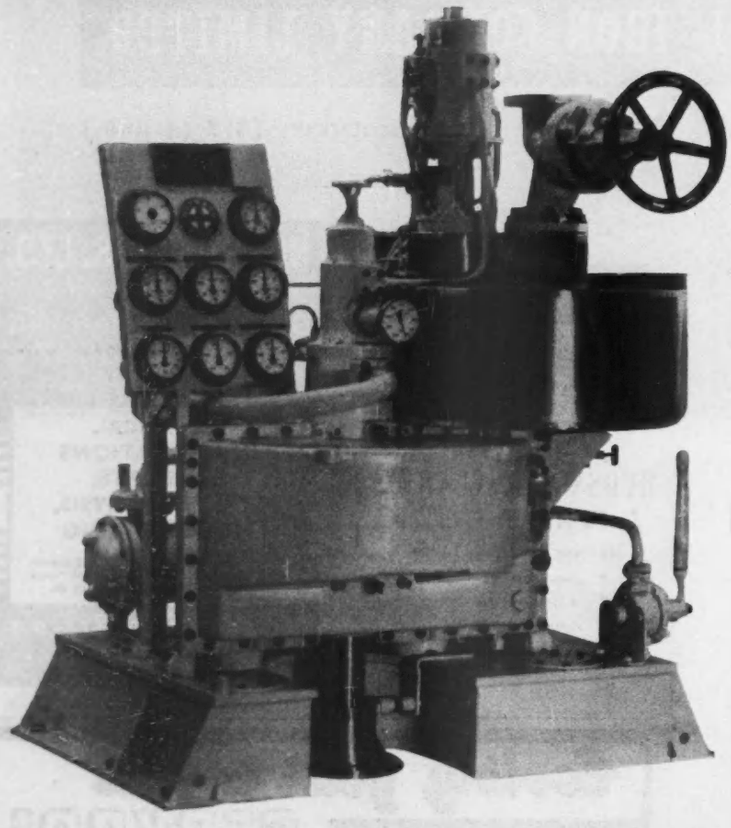

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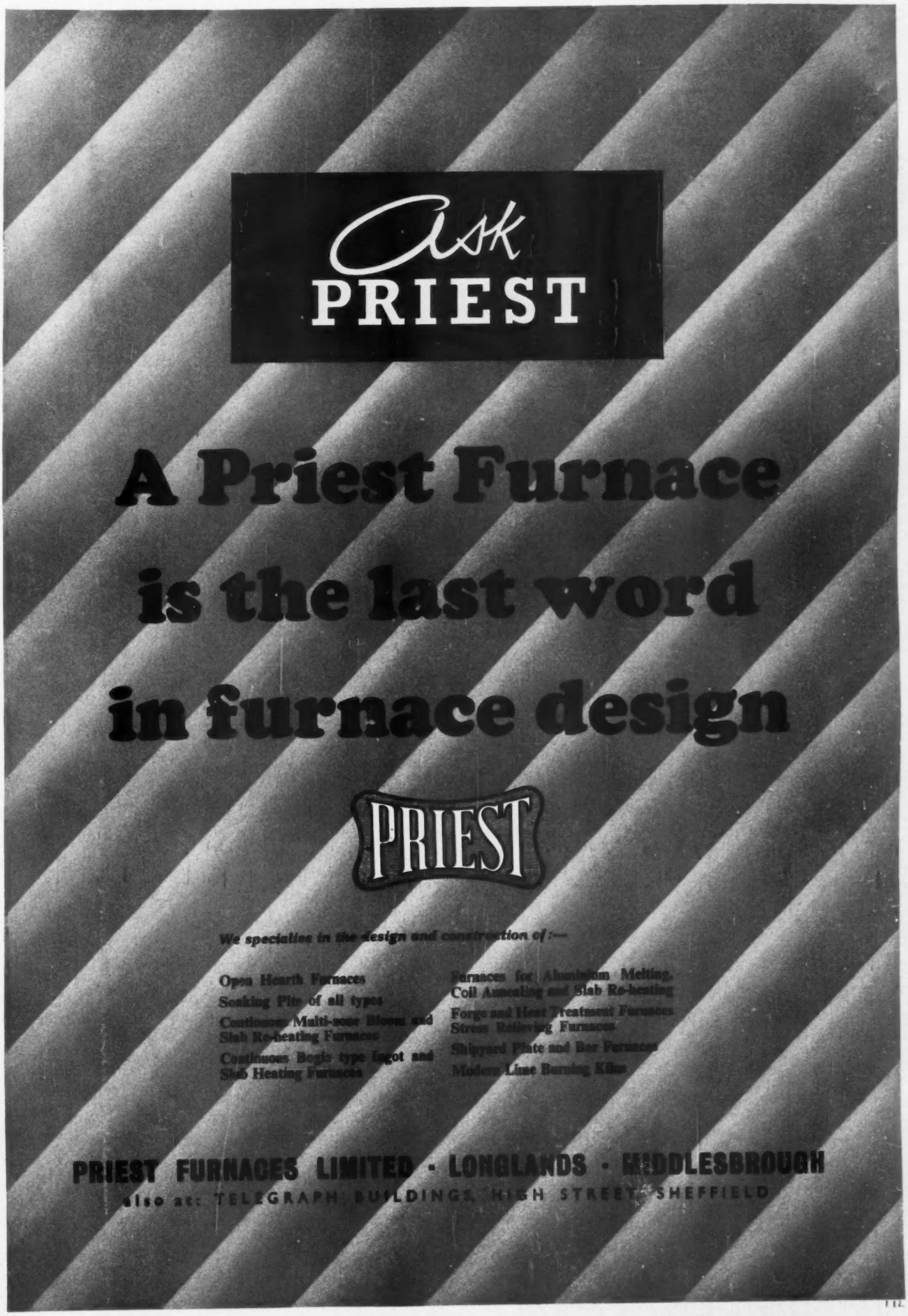
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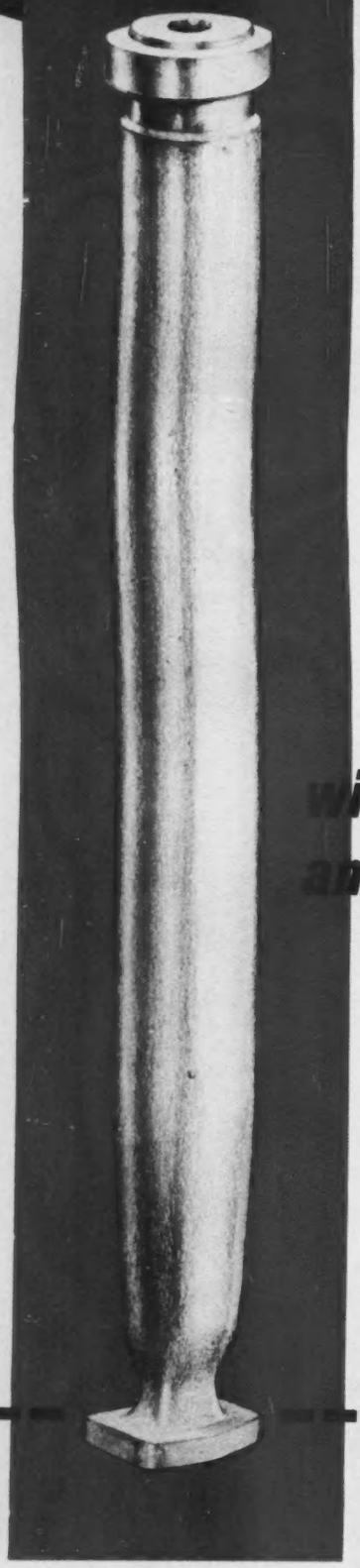

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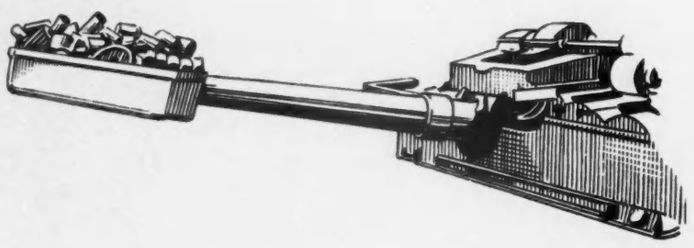

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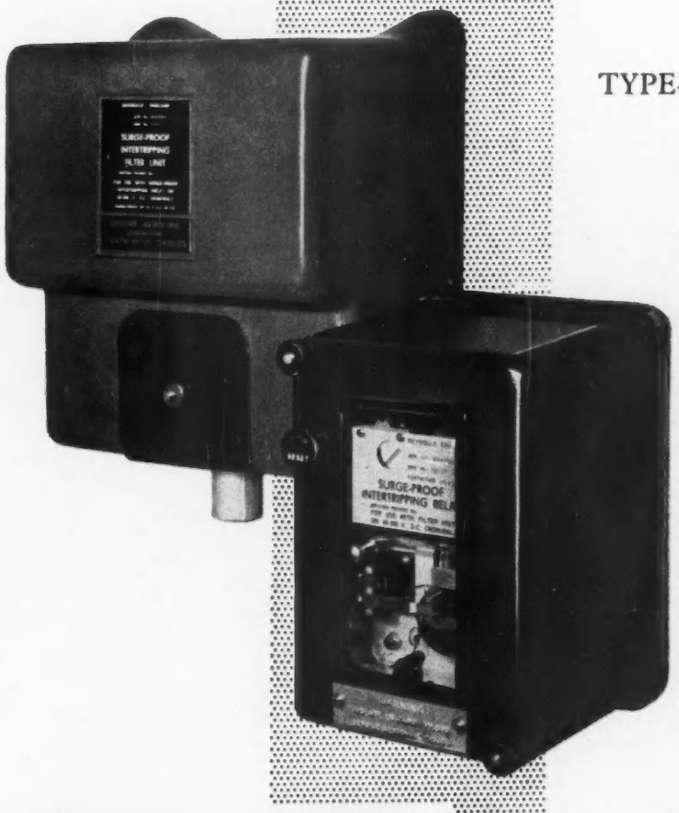

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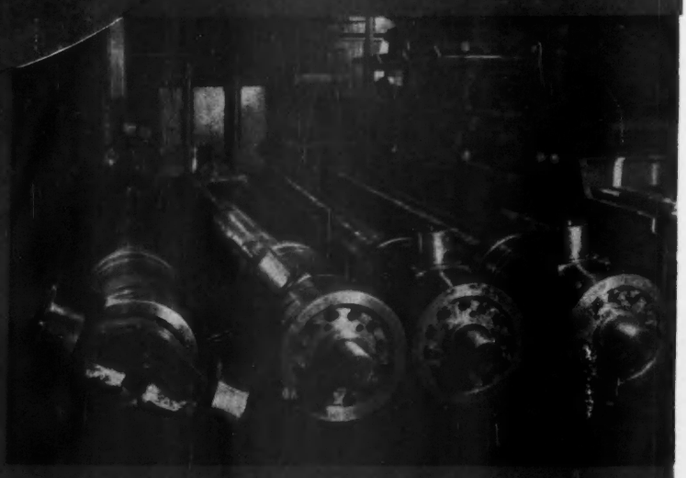

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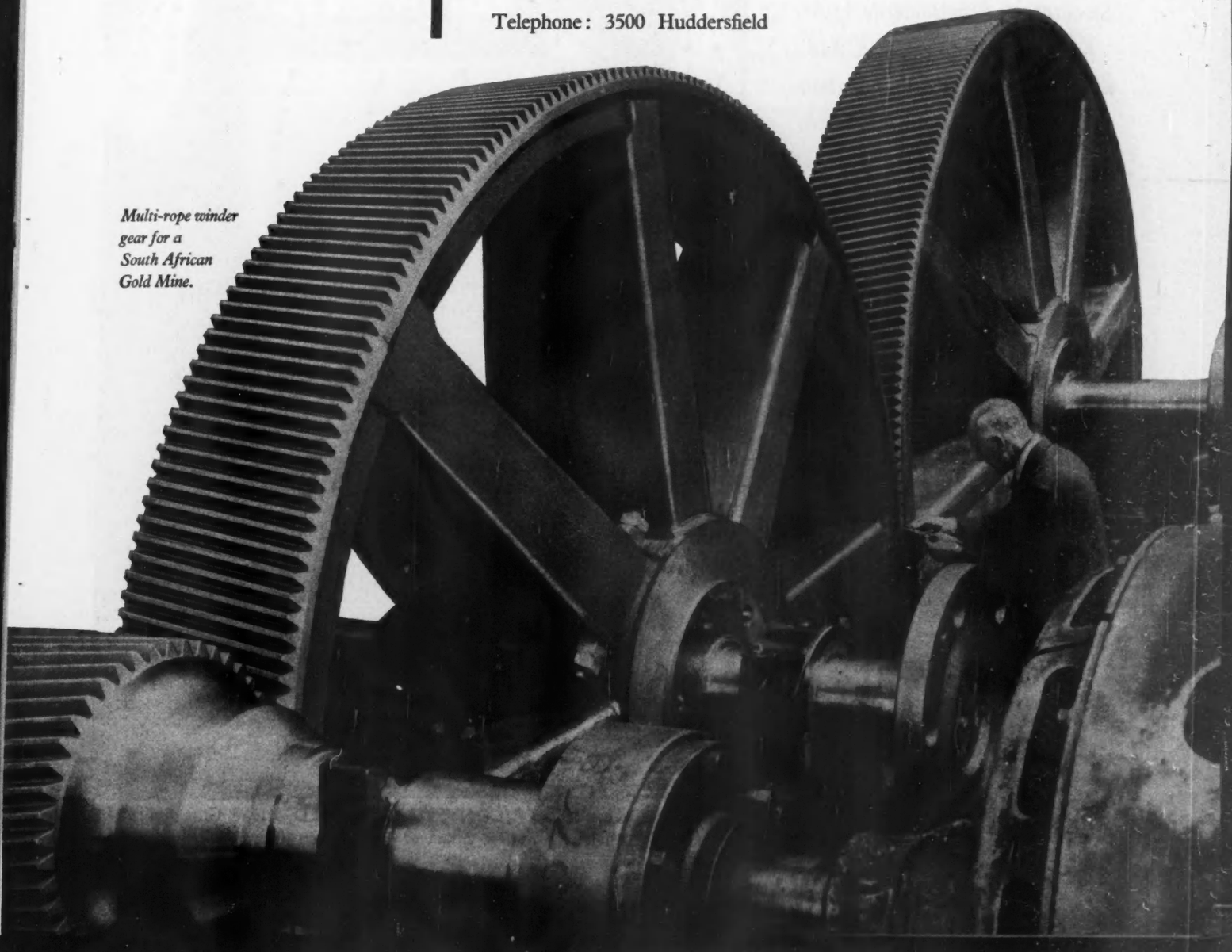

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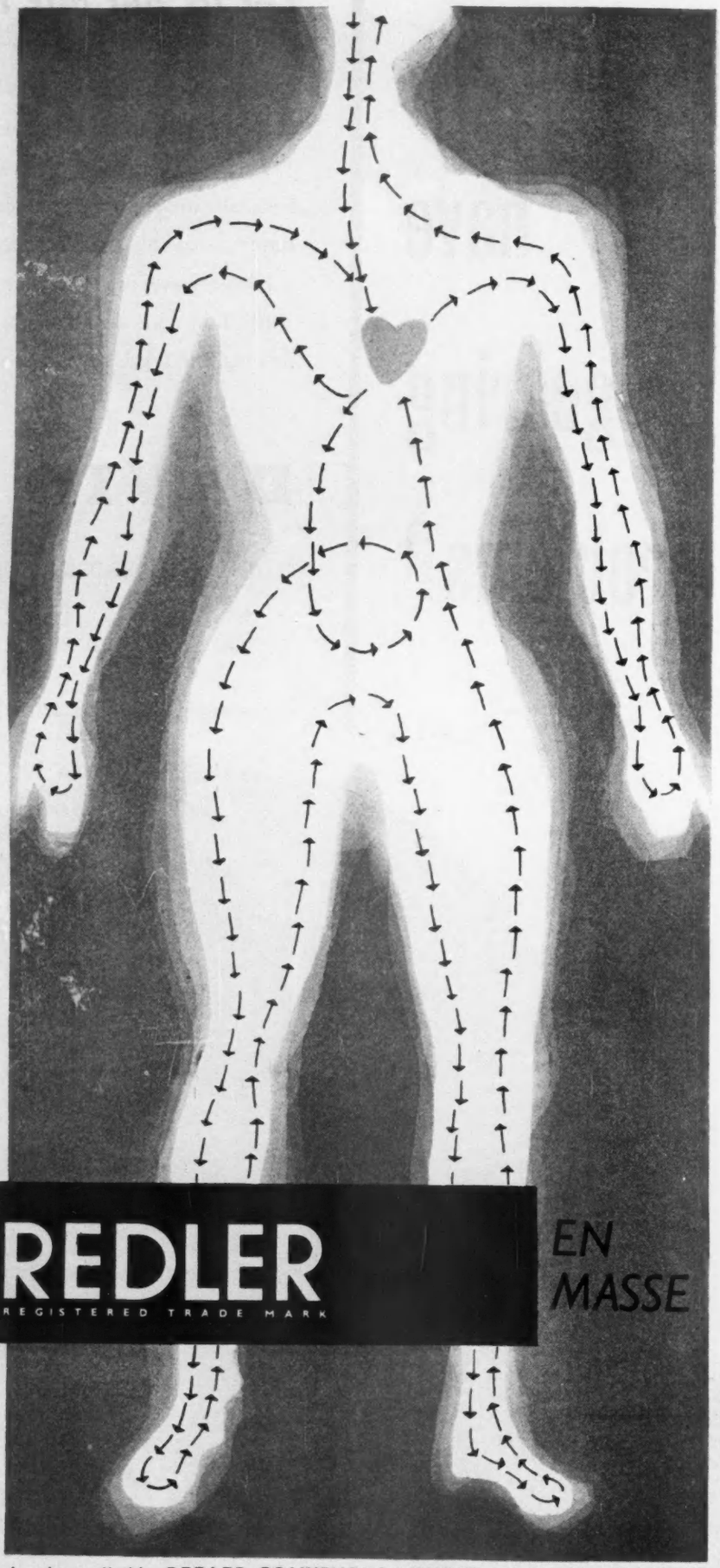

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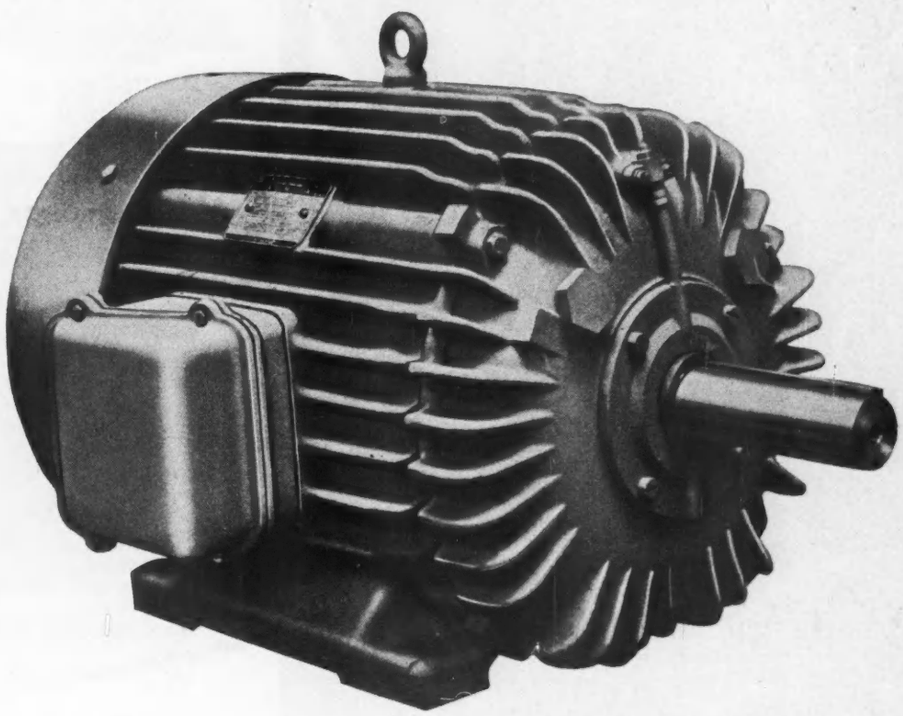

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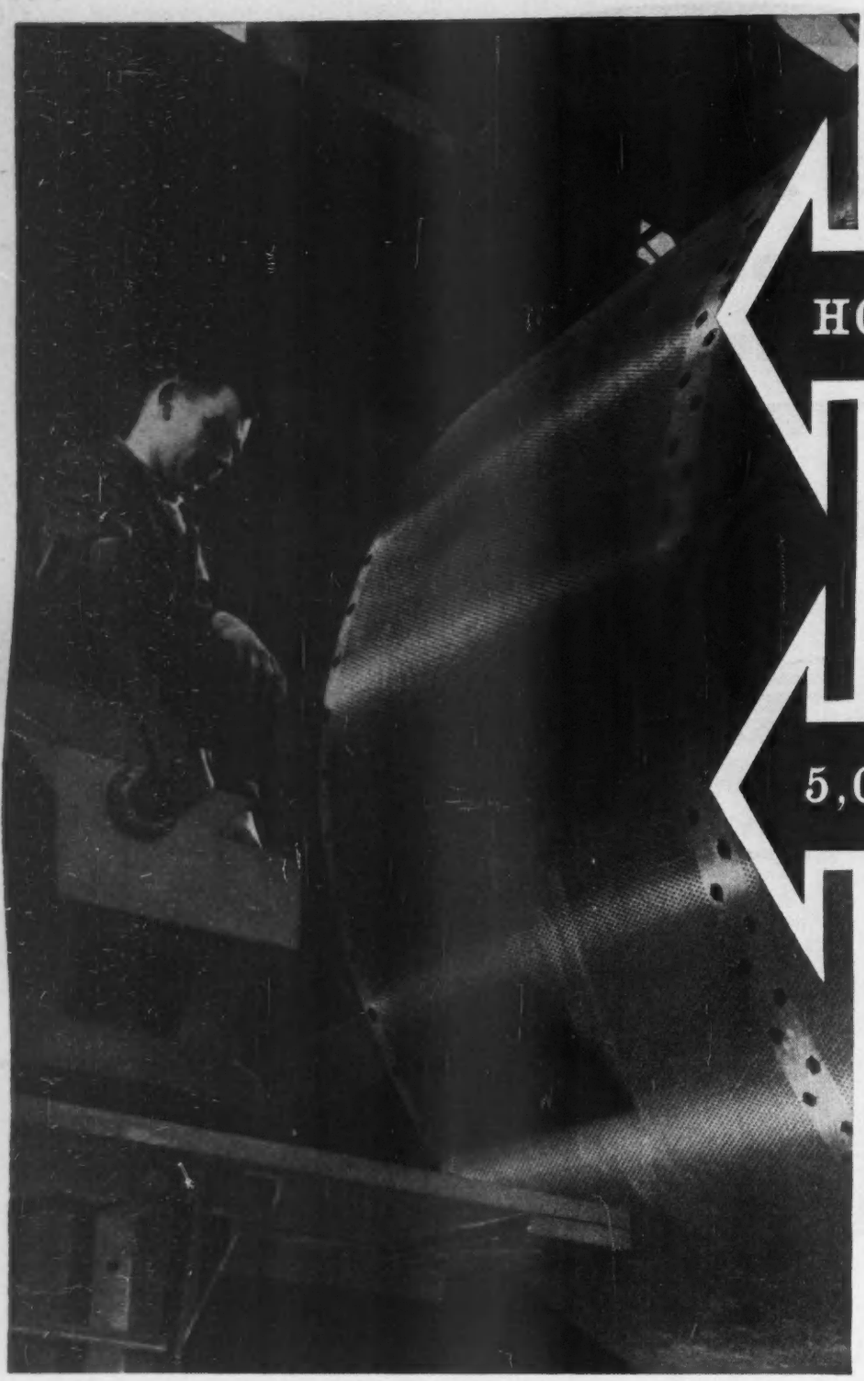

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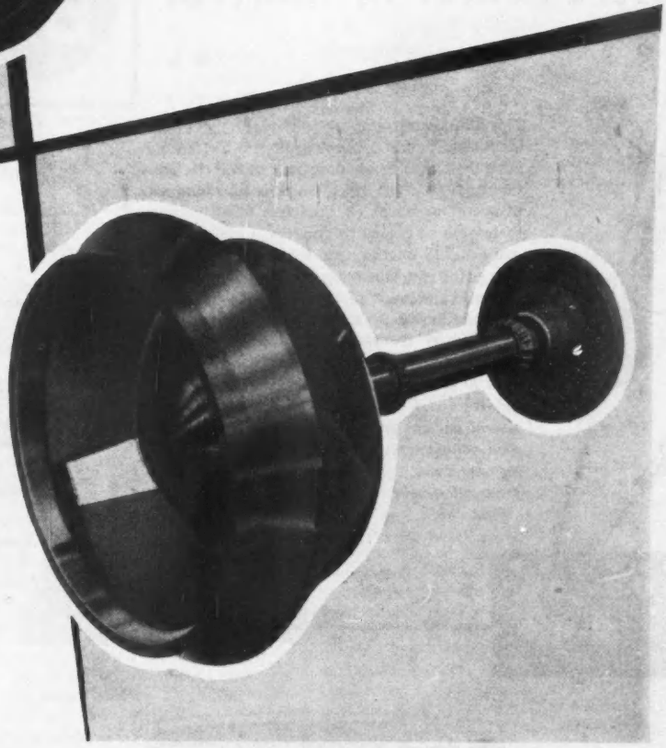

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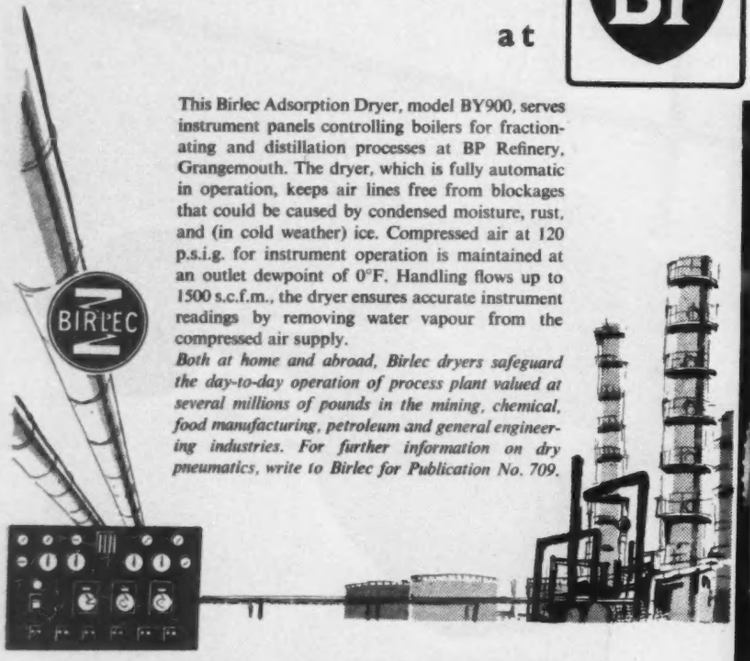

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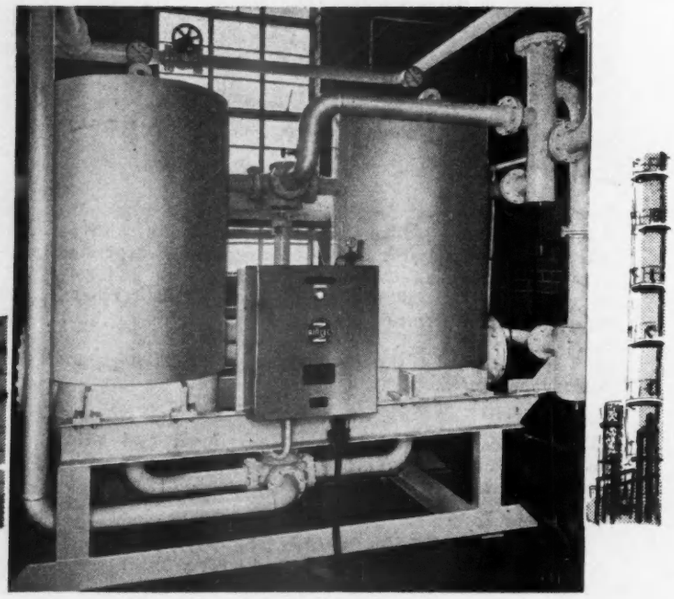

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ENGINEERING

Impact

of Coal Competition

If coal is competitive with other forms of energy, mainly oil and natural gas, then as Europe will in future require much more energy than now being used, there is room for coal consumption to increase.

This is the long term conclusion of *Coal Situation and Prospects in Europe in 1958/59*, a new report of the United Nations Economic Commission for Europe (ECE). Its conclusion is qualified by the statement that while the demand for energy can be expected to increase, the proportion of coal in the energy market will be a declining one, the actual amount of coal used depending on its degree of competitiveness.

The upturn in European industrial activity has not yet had time to show any marked effect on the costly stockpiles of the National Coal Board and the west European nations. The figures for stockpiles are 35 million tons in Britain and 33 million in the countries of the European Coal and Steel Communities.

In the specific coal using sectors of industry, such as blast furnaces and thermal power stations, there was no indication, said the report, that demand would slacken. So as activity in this field increased coal consumption should move with it. Where, as in the domestic field, general industry and on the railways, other forms of energy can easily be brought in, coal was thought to be likely to lose ground.

Adaptability

That production costs in the coal industry must be reduced is pointed out and the report observes the recent increases in productivity and the closing of high-cost pits as evidence that the industry is ready to be adaptable. But fluctuations in demand are liable to occur, such as the last mild winter brought, and they are likely to have serious financial and social consequences. Uninterrupted coal and oil imports may obviously place home coal mining organisations in almost impossible difficulties and the report notes increasing pressure in a number of countries to adjust imports to home production in order to give the coal industry a chance to compete.

Hard coal and lignite, in west Europe, have declined in their proportion of total consumption from 79 per cent in the post-war year of 1950 to 64 per cent on the most recent figures. Petrol products had enjoyed the fastest rise, from 10 per cent in 1950 to 21 per cent. Hydro-electricity had advanced more modestly from 10·5 per cent to 13 and potential sites are becoming scarce.

In Russia and Eastern Europe the coal industries are not encountering the difficulties met in the West. The total coal stocks of Russia, Poland and Hungary do not amount to a third of those of the National Coal Board alone. The coal output of the Soviet *bloc* has in recent years moved up to a situation where supply more nearly meets the demand. Coal accounts for 75 per cent of the total primary energy source, followed by peat, fuel wood and other non-commercial forms, 10 per cent, petrol products 9 per cent, hydroelectricity 3 per cent.

In Eastern Europe 1955 figures show that 90 per cent of the primary energy came from coal, though in 1950 the figure had been up to 93 per cent.

Plans are now going ahead for the building of a pipeline to export 15 to 16 million tons of crude oil a year from the USSR to Poland, Hungary, Czechoslovakia and Eastern Germany. Once it is operating, in the mid-1960s, there may be a sudden sharp lift in standards of consumption in the satellite states.

Help for India

By general agreement in the West the stir on India's border with China was seen to be chiefly of significance in the effects it may have on India's long struggle to raise the living standards of its fast growing millions.

The political battle in Asia will be crucially swung one way or the other as either India or China pulls ahead in the material race.

The announcement of the banker-trio who are to tour India and Pakistan very soon was a close mirror of the realities of trade and aid. The bankers come from America, Britain and Germany. Mr. Joseph M. Dodge, chairman of the Detroit Bank, Sir Oliver Franks, chairman of Lloyds Bank and former UK Ambassador in Washington, and the renowned Dr. Hermann Abs, chairman of the Deutsche Bank.

Thus the three Western trade rivals in India find themselves travelling together on a mission of aid. What are their objectives? Partly, no doubt, to secure some clear understanding in Delhi of the likely volume of international assistance, and what sort of trading credits, may be expected by the authorities there in drawing up their next five year plan. Up to a point they could do that without making the tour, it follows that in addition a better understanding of the needs and difficulties of both India and Pakistan should permeate top level thinking in the West after so articulate a leader as Sir Oliver Franks, and so dynamic a figure as Dr. Abs, have been shown something of the local scene.

Cooperation

Dr. Hallstein of the European Economic Community has put out far reaching views on all the West European nations cooperating in the urgent work of developing the backward territories. Mr. Dillon the United States Under-Secretary of State, is one of many influential Americans who would like to see the two European trade *blocs* coming closer together, not withdrawing further and more intransigently into their tariff shells.

An already functioning example of a pan-European financial collaboration is the £27 million loan to Argentina fixed up in the middle of last month by 51 European banking institutions embracing eight countries. The loan is a stand-by credit for the Argentine Central Bank to be made available through 1960 and repayable over a period beginning in mid-1961. Its overall purpose is to " under-pin " part of a general stabilisation of Argentina's economy which has suffered since the war from more than one change of direction.

of Accident Investigation

Two Fellows of the Royal Aeronautical Society and a Member of the Institution of Mechanical Engineers are members of the committee which Mr. Duncan Sandys, the Minister for Aviation, has set up to review the procedure current in the investigation of civil aircraft accidents.

One of the commonest complaints of recent years and crashes has been the allegation that the first person official inquirers seem to turn to for allocation of blame is the—often dead—pilot. Pilot-error is a term made familiar to the public by the inquiries when often enough the evidence of what really happened as one man coped with the immensely numerous controls and indicators of a modern air passenger transport was that picked out of the mud and foam after an impact of several hundred miles an hour.

The terms of reference of the new commitee, which Sir David Cairns, Q.C., will lead, are to inquire into the law and practice:—

> governing investigations of accidents occurring in the UK to civil aircraft and elsewhere to civil aircraft registered in the UK.

They will also look into conditions governing the issue and cancellation or suspension of Ministry of Aviation flight crew and maintenance engineer certificates.

The two aeronautical Fellows are Sir Frederick Tymms, a former director-general of Civil Aviation in India and past-Master of the Guild of Air Pilots and Air Navigators, and Mr. Peter Masefield, the managing director of Bristol Aircraft. The member of the Mechanicals is Mr. H. C. I. Rogers, who in 1948 became chief engineer of the Imperial Tobacco Company and is now a director. The fourth member of the committee is Mr. William Heywood, a member of the Restrictive Practices Court, former general secretary of a textile union.

Judging Success

Surprising and not always reassuring discoveries came from comparisons made between the amount of capital involved, turnover figures and profits, in some of the 600 firms in which the Labour Party once proposed to make the taxpayer an involuntary shareholder.

The whole question of whether a company is successful or not is controversial and of interest to others beside take-over practitioners. Next Wednesday a conference on just this subject is being held at the Royal Festival Hall, London, by the Centre for Interfirm Comparison and the British Institute of Management.

Dr. T. Barna, of the National Institute of Economic and Social Research, Mr. H. W. G. Kendall, of the British Federation of Master Printers, and Dr. J. M. S. Risk, will be among the speakers before the meeting is opened to discussion.

Interfirm comparison, with its anonymous sharing of commercias vital statistics, provides companies with a valuable indicator of the sort of returns on capital, turnover-to-profits ratio and other succes barometers that are not so easily to be had by the most diligent study of annual reports and accounts.

The techniques applied ensure that a firm, putting its own figures " into the pile " and getting in return an inside view of what other firms in the same or related business activities are achieving, knows that its name will not be used on releases from the firm doing the statistics. Care is also taken to avoid situations where a set of statistics would be easily identifiable.

" Engineering " in America

In American journals dealing with mechanical engineering, the most frequently cited foreign journal published commercially is ENGINEERING.

This finding is taken from the results of an examination carried out by Mr. Robert E. Burton, of Speedway Laboratories, Linde Co., Indianapolis, Indiana, and published in *American Documentation*. Mr. Burton examined the " citation pattern " in the field of mechanical engineering, taking the *ASME Transactions* and the *Journal of Applied Mechanics* as the key American journals in that field. He counted the references to all journals and arranged them in order of frequency of citation.

Apart from the two key journals, he found that the *Proceedings* (A) of the Royal Society topped the poll with 61 citations over the year covered by his examination. Other journals of learned societies, mostly American, scored citations of up to 40 or 50. With 20 citations, ENGINEERING was also the only British commercially-published journal to make the grade and appear on the list at all. Altogether 55 journals appeared on the list.

and " Engineering " Everywhere

Like a fine engine, ENGINEERING is developing from a design that was always basically sound to a form in which there is no superfluous material. With this issue the design of the journal shows further refinements which make for easier and more stimulating reading.

The copy of ENGINEERING before you now could not have been envisaged even ten years ago, for the simple reason that no one could have imagined what enormous strides the engineering industries were to take. Immediately after the Second World War, the pressure to engage in research was stepped up because the pace of armament development had shown that a scientific approach yielded far-reaching results. That same approach, right through from science to sales, is now paying off in everything from civil engineering structures to machines for the home.

Engineering is the art of getting things done, the business of following through from research to giving technical service to the user. That is what ENGINEERING reports. It focuses, simply and significantly, on the technical heart of the matter, and lights up, too, the commercial, economic and political changes which affect the course of technical development.

Solid Lubricants: How and Why They Work

Dispersions of solid particles in liquid as well as chemical coatings are included in this comprehensive review of solid lubricants.

By Dr. J. Gaensheimer

Alpha-Molykote Corporation, Stamford, USA

In boundary and mixed lubrication, additives have been successfully used for a long time to reduce friction and wear, acting as true solids by reaction with the metal surfaces. In the same way, dispersions of solids in liquids have been increasingly used in lubrication, and for many purposes, dry solid lubrication has proved to be the only way of solving frictional problems.

Solid lubricants may be classified into the following groups, according to their chemical and physical structures:
Inorganic solid lubricants:
(*a*) with layer lattice structure; (*b*) other inorganic compounds; (*c*) inorganic conversion coatings; (*d*) metals.
Metal organic and organic solid lubricants:
(*a*) EP additives; (*b*) waxes, fats, soaps, and fatty acid salts; (*c*) plastics.

INORGANIC SOLID LUBRICANTS

(*a*) *Lubricants with layer lattice structure.*—The two best known and most used representatives of this group, undoubtedly, are graphite and molybdenum disulphide.

Graphite[1] is extensively used as a lubricant. Its lubricity is attributed to its layer lattice structure. Numerous investigations during the past years, however, have shown that this theory is a simplified explanation of the problem. Apparently the adsorbed liquid and gas molecules play a decisive role in the lubrication by graphite. But by the addition of inorganic materials, such as barium fluoride or lead iodide, a good lubricating effect may also be obtained in high vacuum.

If graphite is heated in air, it will react with the oxygen in the air and carbon dioxide will form, a gas. This reaction starts noticeably at 450° C (842° F). Since a gas is formed as a reaction product, no abrasive particles will remain after the oxidation.

Molybdenum disulphite products[2] have been on the market for only 11 years. The most plausible explanation for its effectiveness as a lubricant again is its layer lattice structure. The crystals exhibit excellent adhesiveness on metal surfaces. In contrast to graphite, molybdenum disulphide retains its lubricity even in high vacuum. Its oxidation in air into molybdenum trioxide starts slowly approximately at 300° C (572° F) and rises sharply at 400° C (752° F) depending on particle size and time of exposure. The resulting molybdenum trioxide no longer acts as a lubricant, it is rather slightly abrasive and a weak acid. But even at high temperatures, molybdenum disulphide may retain its lubricity for an extensive period of time, as long as only the surface of the lubricating film oxidises and a thin, non-oxidised molybdenum disulphide layer is still present. Similar to graphite, the stability of molybdenum disulphide against chemical attack and atomic radiation is very high. Graphite and molybdenum disulphide are always used as dry powders; in form of a dispersion (pastes and greases should be included in this category); or as bonded coatings.

For many purposes it is adequate to apply the powder by using a rag or a paper napkin tissue by hand to the surface. Tumbling is also an excellent method if the powder is to be applied on numerous small parts.

With graphite, due to its low specific weight of 2 to 2·3 as compared to the specific weight of 4·7 to 4·8 of molybdenum disulphide,[4] and due to its easily obtainable small particle size, stable suspensions may be prepared without great difficulty. This however, is a real art in the case of molybdenum disulphide. Dispersions[3] are primarily used as EP additives for liquid lubricants and metal working fluids. Pastes are mixtures of the solid lubricant in liquids; they contain a high concentration of solid lubricant and are used in cases which do not permit the application of dry solid lubricants, such as inaccessible lubrication areas or where the application of the powder is too complicated. They may easily be applied on surfaces by coating with a brush. The lubricating properties of conventional greases may be fortified by the addition of solid lubricants; they will then resist higher pressures and diminish wear.[5]

Dispersions of solid lubricants are commercially available in all liquid lubricants, such as mineral oils, polyglycols, silicone oils[6], diester oils, or volatile liquids such as water or low-boiling hydro-carbons, which evaporate during operation, leaving a solid lubricant film on the surface.

When using dry lubricants in the form of bonded coatings[7], the solid particles are, together with a binder, dispersed in a suitable volatile solvent so that they may be applied to surfaces by brushing, dipping, or spraying, exactly like a paint or varnish. Practically all resins and plastics have been investigated and tested for these purposes. As a direct result, several bonded coatings are now on the market, which are either air-drying or must be baked at elevated temperatures, such as at 150° C for 60 minutes. These bonded coatings are applied at a thickness of 0·0002 to 0·0003 in; often they provide lubrication for the life of the workpiece.

The bonded coatings lead directly to another technique for application of solid lubricants, namely, in mixture with plastics, such as nylon, where they provide this abrasion-stable polymer with a low friction coefficient or added to sintered metals, where they transfer their good lubrication properties to the latter.[8]

(*b*) *Other inorganic compounds.*—Besides inorganic layer lattice compounds other inorganic materials have also been investigated for their suitability as lubricants, such as boron trioxide, various ceramic materials and, primarily, basic lead carbonate (" white lead ") and lead monoxide.[9] The latter is said to be suitable for lubrication, primarily at very high temperatures, namely, approximately 700° C. These lubricants have not yet gained great or practical significance.

(*c*) *Inorganic conversion coatings.*—Mainly zinc, iron, and manganese-phosphate layers, or mixtures of them, are produced on iron and steel surfaces.[10] It has been discovered that especially iron and manganese-phosphate layers reduce the scoring of machine parts, which occurs especially during wear-in of new parts, and that especially zinc-phosphate layers facilitate the forming of steel. In both cases the result is particularly good if, together with the phosphate layer, conventional lubricants, liquid or solid, are used. Phosphate layers have been used for the forming of steel, particularly in drawing wires, rods, tubes and cups.

Recently, attempts have been made to produce the phosphate layer and the lubricant layer, in one operation on the metal surface, by using long-chain organic phosphorous compounds. The phosphorous group of the compound reacts with the metal and is intended to effect good adhesion, while the organic radical is intended to assume the function of lubrication.[11]

The best phosphate layers are produced by the dipping process, though they may be produced by all conventional methods, such as brushing, spraying, and tumbling. Particularly good phosphate coatings are obtained on iron, zinc, and cadmium surfaces, while aluminium and magnesium are less suitable. Therefore, fluorine-containing chromium baths are used for these light metals, which produce very adhesive oxide and oxide-chromate layers. Besides these phosphate layers, oxide, sulphide, chloride, and oxalate layers have been described in literature and applied.

(*d*) *Metals as lubricants.*—With increasing load a reduction in friction coefficient may be observed. For example, for an indium film on hard steel, at a load of 1 kg a friction coefficient of 0·2 was measured, which dropped to 0·04 at a load of 8 kg. A practical application for the lubrication by soft metal films is two-component bearing metals, such as copper-lead bearings, where during sliding the soft lead is smeared over the surface and behaves like a soft metal film on a hard base. Indium, lead, tin, zinc, copper and barium have found practical applications for these purposes.

METAL ORGANIC AND ORGANIC SOLID LUBRICANTS

(*a*) *EP additives.*[12]—The listing of EP additives under the term " solid lubricants " may be surprising but it will become intelligible from the standpoint of the action of these compounds. All chemical additives which are used in solution for increasing the load capacity of liquid lubricants, are effective only after reacting chemically

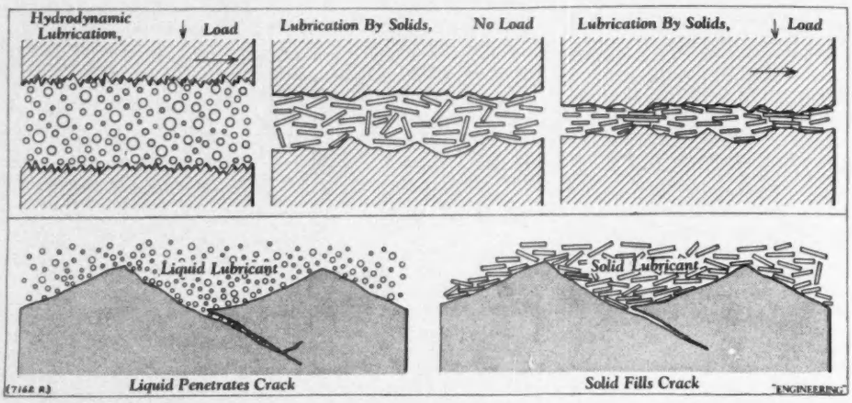

Fig. 1 (top) An easily sheared film still remains when a load is applied in presence of solid lubricants.
Fig. 2 (bottom) Absence of surface pitting with solid lubricants is attributed to their filling cracks.

Shortened version of paper presented at the Seminar on Friction, Lubrication and Wear, Lucerne, Sept. '59.

with the metal surfaces. During this reaction, solid products are formed which are firmly bonded to the surfaces and contribute in the same manner to the reduction of friction as do solid lubricants. They show the advantage of being formed repeatedly from the solution, at the same rate as they are lost as lubricants by abrasion.

These EP additives consist mostly of compounds containing lead, other heavy metals, sulphur, phosphorous, chlorine, or combinations of these elements. This decomposition of the EP additives and their reaction with the metal surfaces, noticeably occurs only at elevated temperature, as has been shown by measurements of additives with radioactive tracers.[13]

A strongly idealised schematic presentation of the behaviour of EP additives compared to ordinary mineral oils is shown in Fig. 3.

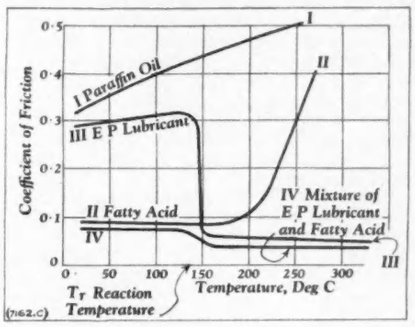

Fig. 3 Simplified frictional behaviour of various lubricants as a function of temperature.

Curve I shows the behaviour of paraffin oil. The initially high friction curve climbs with rising temperature. Curve II shows the behaviour of a fatty acid which, due to soap formation with the metal, exhibits low friction values up to the melting point of the soap. Curve III shows an EP additive which reacts only very slowly with the surface at low temperature. From a temperature T_r, marked reaction starts and good lubrication properties are assured up to high temperatures. Curve IV shows the advantages of both of them. Up to point T_r, the soap gives good friction values, then the EP additives assume this function.[14]

Other additive agents should be present which have a wear-reducing effect at slow motion and low temperature, such as previously mentioned fatty acids or phosphate layers or solid lubricants dispersed in the EP oil, which may effect the separation of the surfaces in this range and may then, at higher temperature, i.e., at higher velocities, be supported by the EP additives.

In a manner similar to EP additives, attempts have recently been made to employ gaseous reactive lubricants at high temperatures, such as fluorine and chlorine substituted methane derivatives. In several cases, again dependent on the type of metals present, these gases prove to be effective lubricants, especially if adequate numbers of chlorine atoms are present to form a solid chloride film on one or both of the sliding surfaces.[9]

(b) Waxes, fats, soaps, and fatty acid salts.—This group of organic solid lubricants comprises all fats, waxes and soaps, such as aluminium, calcium, zinc, magnesium, sodium, lithium salts of fatty acids, paraffin wax, bees wax, candelilla wax, carnauba wax, fats like tallow, lard, and fatty acids, such as stearic acid and palmitic acid, etc.

These compounds are generally limited in their applications, mainly due to their relatively low melting point or, in the case of fatty acids, due to the melting point of the reaction products of these acids with the metal surface. They are applied in the form of solutions or rubbed on the surface to which they generally adhere very strongly. They are most extensively used in drawing and forming metals, where they are generally applied together with carriers, such as lime or phosphate layers.

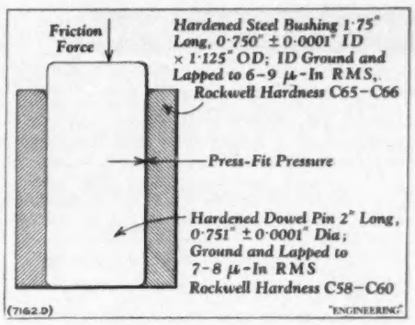
Friction Force
Hardened Steel Bushing 1·75" Long, 0·750" ± 0·0001" ID × 1·125" OD; ID Ground and Lapped to 6–9 μ-In RMS, Rockwell Hardness C65–C66
Press-Fit Pressure
Hardened Dowel Pin 2" Long, 0·751" ± 0·0001" Dia; Ground and Lapped to 7–8 μ-In RMS Rockwell Hardness C58–C60
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Fig. 4 The press fit test.

(c) Plastics.—When investigating the frictional behaviour of plastics, it was found that Teflon, polytetrafluoroethylene, $(-CF_2-CF_2-)_n$ exhibits a much lower friction coefficient than all other polymers.[14]

While the friction coefficients of polymers may generally be compared with those of metals, Teflon[15] exhibits a much lower one. Its lubricity is not affected by liquid lubricants and, according to Bowden and Tabor, it remains unchanged up to a temperature of almost 300° C. The poor heat conducting properties of all polymers constitute a problem.

Lately, bonded coatings have been marketed with Teflon incorporated as a pigment and which are intended to make the transfer of the good lubricating properties of Teflon on numerous mechanical parts possible. A phenol resin is used as a binder. Actual practical proof is still missing. Likewise, homogeneous mixtures of polytetrafluoroethylene and graphite, molybdenum disulphide or metal powders are said to make a lubricant for use at high temperatures.

As a simple, sensitive and reliable testing method, the press fit test[16] was used for investigating many solids of some of the aforementioned categories. This test gives in a very short time information on the behaviour of a lubricant, under the conditions of high load and low velocity and is mainly used as a preliminary test. Its working principle is shown in Fig. 4.

Results are summarised in the table. From this table, it becomes apparent—in agreement with industrial applications—that especially molybdenum disulphide, graphite, waxes, soaps, and phosphate coatings are suitable as solid lubricants.

Friction Coefficients of Various Solid Lubricants. (Steel Versus Steel, Press Fit Test)

Solid lubricant	Friction coefficient		Stick slip
	Kinetic	Static	
Inorganic solid lubricants with layer lattice structure:			
Molybdenum disulphide, natural	0·050	0·053	No
Molybdenum disulphide, synthetic	0·091	0·106	No
Tungsten disulphide	0·090	0·098	No
Titanium disulphide	0·25	—	Yes
Tellurium disulphide	0·25	—	Yes
Selenium disulphide	0·25	—	Yes
Graphite, natural	0·25	—	No
Graphite, colloid in water (22 per cent)	0·100	—	No
Boron nitride	0·25	—	Yes
Barium hydroxide	0·151	0·163	No
Lead chloride	0·191	0·214	No
Mica	0·25	—	Yes
Silver iodide	0·231	0·245	Yes
Talcum	0·25	—	Yes
Other inorganic compounds:			
Borax	0·210	0·226	No
Kaolin	0·25	—	Yes
Tottenstone	0·189	0·195	No
Lead oxide-zinc oxide	0·25	—	Yes
Vermiculite	0·160	0·167	No
Chemical surface layers:			
Iron-manganese-phosphate layer	0·213	0·218	No
Iron-manganese-phosphate layer, molybdenum disulphide rubbed on	0·067	0·074	No
Sulphide melt (570° C) "Sulfinuz"	0·242	—	No

Solid lubricant	Melting point, deg C	Friction coefficient		Stick slip
		Kinetic	Static	
Metal Organic and Organic Solid Lubricants				
Waxes and stearates:				
Spermaceti wax	43-49	0·048	0·062	No
Beeswax	60-63	0·050	0·055	No
Bayberry wax	44-49	0·054	0·070	No
Synthetic wax (comm. av.)	93-96	0·061	0·062	No
Polyethyleneglycol (high MW)	53-56	0·077	0·078	No
Hydrogenated tallow glyceride	59-63	0·082	—	No
Candelilla wax	67-70	0·099	0·113	No
Paraffin	49-77	0·104	0·112	Yes
Montan wax	78-90	0·108	0·120	Yes
Carnauba wax	83-86	0·143	0·169	No
Diethylene glycol stearate	54-59	0·083	0·089	No
Calcium stearate	157-163	0·107	0·113	No
Aluminium stearate	129-160	0·114	0·119	No
Sodium stearate	198-210	0·164	0·192	Yes
Lithium-12-hydroxy stearate	210-215	0·211	0·218	No

NOTE.—A friction coefficient of 0·25 represents the maximum loading capacity of the test fixture used. Wherever 0·25 appears in the table above, a higher coefficient must be assumed.

REFERENCES

[1] Savage, R. H., "Graphite Lubrication," pp. 1-10, *J. Appl. Phys.*, vol. 19, 1948; Braithwaite, E. R., "Graphite and Molybdenum Disulphide—Factors Affecting their Lubricating Properties in Reactors," pp. 107-110, *Nuclear Engineering*, March 1957; Boyd, J. and Robertson, B. P., "The Friction Properties of Various Lubricants at High Pressures," pp. 51-56, *Trans.* ASME, vol. 67, 1945; Campbell, W. S. and Rose Kozak, "Studies in Boundary Lubrication. The Wear of Carbon Brushes in Dry Atmospheres," pp. 491-498, *Trans.* ASME, vol. 70, 1948; Deacon, R. F. and Goodman, J. F., "Lubrication by Lamellar Solids," pp. 464-482, *Proc.* Roy. Soc. A, vol. 243, 1957; Mordike, B. L., "The Lubrication of Solids at High Temperatures," ASLE Meeting, April 1959, Buffalo, NY.

[2] Bisson, E. E., John, R. L. and Swikert, M. A., "Friction, Wear and Surface Damage of Metals as Affected by Solid Surface Films," Paper 31, Conference on Lubrication and Wear, Oct. 1957, London; Lavik, M. T., "High Temperature Dry Film Lubricant—Research and Development," Air Force-Navy-Industry Lubrication Conference, Feb. 1959, Dayton, Ohio; Johnson, V. R. and Vaughan, G. W., "Investigation of the Mechanism of MoS_2 Lubrication in Vacuum," pp. 1173-1179, *J. Appl. Phys.*, vol. 27, 1956; I-Ming Meng, "Lubricating Properties of Molybdenum Disulphide," ASLE Meeting April 1952, Cleveland, Ohio.

[3] Hirano, F. and Yamamoto, S., "Four Ball Test on Lubricating Oils Containing Solid Particles," pp. 249-263, *Wear*, vol. 2, 1958/9.

[4] *Lange's Handbook of Chemistry*, Handbook Publishers, Sandusky, Ohio, 1956.

[5] Smith, E. E., "Molybdenum Disulfide as a Grease Additive," pp. 20-36, *NLGI Spokesman*, Dec. 1956; Kullman, W. W., "Die Wirkung von Molybdaendisulfid als Hochdruckzusatz zu Waelzlagerfett," p. 380, *Endoel und Kohle*, vol. 9, 1956; White, H. S. and Zie, D., "Static Friction Tests with Various Metal Combinations and Special Lubricants," pp. 292-298, *Jour.* Res. Nat. Bur. Stand., vol. 46, (4), 1951.

[6] "The Coefficient of Friction of Molybdenum Disulfide-Silicone Mixtures," "Molybdenum Disulfide as a Lubricant," Climax Molybdenum Co., 1954.

[7] Godfrey, D. and Bisson, E. E., "Bonding of Molybdenum Disulfide to Various Materials to Form a Solid Lubricating Film, 1—The Bonding Mechanism," NACA Tech. Note 2628, Feb. 1952; Kingsbury, E. P., "Solid Film Lubricants at High Temperatures," ASLE Meeting Oct. 1957, Toronto, Canada; Berry, L., "Solid Lubricant Coatings," ASME-ARS Joint Aviation Conference, Dallas, Texas, March 1958.

[8] Johnson, R. L., Swikert, M. A. and Bisson, E. E., "Friction and Wear of Hot Pressed Bearing Materials Containing Molybdenum Disulfide," NACA Tech. Note 2027, Feb. 1957; "Frictional Properties of Porous Metals Containing Molybdenum Disulfide," *Research*, vol. 3 (8), 1950; Bowder, F. P. and Shooter, K. V., "Frictional Behaviour of Plastic Impregnated with Molybdenum Disulfide," *Research*, vol. 3, (8), 1950.

[9] Lavik, M. T. and Daniel, T. B., "Development and Evaluation of High Temperature Solid Film Lubricants," Midwest Res. Inst. Quant. Prog. Rep. No. 1, 1959; Johnson, R. L. and Gliney, H. E., "High Temperature Friction and Wear Properties of Solid Bonded Lubricant Films Containing Lead Monoxide," ASLE Meeting, April 1959, Buffalo, NY; Bisson, E. E., Johnson, R. L. and Anderson, W. J., "On Friction and Lubrication at Temperatures to 1000° F with Particular Reference to Graphite," ASLE-ASME Lubrication Conference, Toronto, Canada Oct. 1957; Peterson, M. B. and Johnson, R. L., "PLO and Other Metal Oxides as Solid Lubricants for Temperatures to 1,000° F," ASLE-ASME Meeting, Oct. 1956, Atlantic City, NJ; Sliney, H. E., "Lubricating Properties of Lead Monoxide Base Coatings of Various Compositions at Temperatures to 1,250° F," NASA Memo. 3-2-59E.

[10] Milne, A. A., "Experiments on the Friction and Endurance of Various Surface Treatments Lubricated with Molybdenum Disulfide," pp. 92-103, *Wear*, vol. 1, (2), Oct. 1957; Machu, W., "Die Phosphatierung," Verlag Chemie, Weinheim, 1950; "Phosphating Treatments—Patent Literature Survey," *Metal Finishing*, April 1958.

[11] US Patent 2,840,498, 1958, Logue, E. E., "Composition and Method for Producing Combination Corrosion Resistant Lubricating Coatings on Metals."

[12] Smalheer, C. V. and Mastin, T. W., "Lubricant Additives and Their Action," pp. 337-346, *Jour.* Inst. Petr., vol. 42, 1956.

[13] Loeser, E. H., Wiquist, R. C. and Twiss, S. B., "Cam and Tapped Lubrication III—Radioactive Study of Phosphorus in the EP Film," ASLE Meeting, April 1958, Cleveland, Ohio.

[14] *Friction and Lubrication*, Bowden, F. P. and Tabor, D., Methuen & Co., London, 1956.

[15] Davies, C. B., "A Review of Boundary Lubrication," pp. 244-253, *Wear*, vol. 1 ,(3), 1957; Brit. Patent 787,359; Blaines, A., Twiss, S. B., Wilson, P. J. and Snyder, E. J., "Friction of Teflon as a Dry Lubricant Bearing," ASLE Meeting, April 1957, Detroit, Michigan; Allan, A. J. G., "Plastics as Solid Lubricants and Bearings," ASLE Meeting, April 1957, Detroit, Michigan; "Ptfe Bearing Materials," pp. 123-128, *Modern Plastics*, Feb., 1959.

[16] Sonntag, A., "Solid Lubricants for Extreme Pressures," pp. 63-66, *Product Engineering*, June 1959.

Plain Words

Now that the 1960's are upon us, what great works can we reasonably hope to complete in the coming ten years? I have made a list of ten targets for the 1960's—one for each year. Which have a reasonable chance of success and which are doomed to neglect?

Certainly near the top of the list I place the reduction of noise. The literature of noise reduction is probably not very extensive but there is more of it than most people think, and it can be helpful in developing quieter designs now. All power to the noise reducers.

Although research is needed for noise reduction, I believe the big battle for more research generally is virtually won. It has taken many years to convince everyone, but now we should turn our attention to the wider application of existing information. There is a great opportunity there.

Which brings me to my third target—water supplies as adequate as our electricity supplies. No further comment.

Fourthly, I hope someone will develop a road surfacing material which can be laid and rolled up like a carpet so that renewals can be carried out overnight with the minimum of interference to traffic.

Next, but perhaps most important of all, I fervently hope that we rid ourselves of the blind worship of a higher school leaving age. If we need more education let us have it when a man is in his thirties or forties and has a background of experience, rather than in his 'teens when he may grow tired of school and prefer to work.

While we are on education, here is the sixth target: to do away with the largely artificial frontier between arts and sciences. It is not something that is built into a schoolboy; it is put in by schoolmasters.

One more education topic: to rid ourselves of the idea that Oxford and Cambridge are *real* universities and the others are only the next best thing.

And three for politics: (1) the Conservatives to grow out of their fear of planning (they don't suffer from it in planning an election campaign); (2) the Socialists and the Conservatives to grasp the problems of the nationalised industries without shooting off on party political tangents; (3) if we succeed in banishing war and our most serious black mark is local unemployment, that we should make national heroes of those who sacrifice not their lives but their livelihoods. The temporarily unemployed are often doing a necessary job for the country.

Like sheep to the dipping troughs, we all return, somewhat unwillingly, to our offices after the holiday or after a weekend. Maybe it is one of the unrecognised marks of civilisation which we of the West are bestowing on the rest of the world: the ability and willingness to spend most of our active hours in offices and around committee tables. In the evolution of man this capacity to work through paper and talk is of very recent general adoption. Already it is the method by which most of the world's work is organised and much of it is done. I know men who insist on spending regular periods on the shop floor for fear of losing their practical sense of engineering, yet even they have to devote most of their time to the desk.

If we are to hit those ten targets in the 1960's, it will be by work in our offices—through paper and talk.

CAPRICORN

Letters to the Editor

The Architect has Prime Responsibility

SIR, Although I accept that there are some structures which are so predominantly engineering in character that the engineer may be the right person to lead the design and building "team," I would like to comment on the reasons drawn by Mr. A. V. Hooker in his letter to you (ENGNG., 11 Dec. '59, p. 599) for reaching this conclusion.

He has quoted my article (ENGNG., 27 Nov. '59, p. 543) slightly out of context. I did state that "engineers lack . . . an appreciation of design . . .", but I did so in relation to their training and not as a generalisation applicable to all engineers.

My point, which I think is clear when read with the context of my article, is that at present neither in pre-graduate, nor in post-graduate stages of the education of engineers, is any definite study given to the appreciation of design in the widest sense. If building design is to obtain the best from the contribution of engineers, and the best collaboration between them and architects is to be achieved, I think it is necessary that engineers are at some stage taught the principles of design from the aesthetic aspect. This is important when, as Mr. Hooker says, there are now available to them so many structural media from which designs may be developed, but even more so if engineers are going to lead the design teams for certain engineering types of structures.

Yours faithfully,
E. D. JEFFERISS MATHEWS.

3 Ebury Street,
London, SW1.
21 December, 1959.

Welding Thick Plates

SIR, May I refer to the statement contained in your Atomic Review paragraph entitled "Welding Causes Delay at Chinon"? This paragraph records that "The heaviest plate so far proposed for site welding by British consortia is 3½ in at APC's Trawsfynydd." (ENGNG., 11 Dec.'59, p. 607).

I would point out that about a quarter of the shell plates of the reactor pressure vessels at Bradwell Power Station are of 4 in nominal thickness and fabrication of these was started about two years ago.

Yours faithfully,
H. F. ABLITT.

Hydowne, The Downs,
Maldon, Essex.
17 December, 1959.

Editor's Note: The top and bottom caps of the Bradwell reactor vessel, fabricated in six sections, are, as Mr. Ablitt points out, made of 4 in plate in order to reduce the stresses at the vessel supports and at the fuel standpipes. The nominal thickness of the pressure vessel plates, however, is given in most published descriptions as 3 in.

Dumping Atomic Wastes

SIR, I have just read with a great deal of interest the Atomic Review entitled "Proposal and Disposal," which deals with a subject on which I have a few rather unconventional ideas (ENGNG., 27 Nov.'59, p. 534).

The three requirements governing the disposal of highly radioactive wastes are that they should be contained, shielded and cooled for a very long time. This immediately suggests that such wastes should be disposed of in some permanently cold region of the globe. For countries like Canada, the United States and Russia, no problem exists. We all have vast areas of permafrost which are admirable for this purpose. Drums of appropriately concentrated radioactive liquids or solids could be deposited in relatively shallow holes in permafrost and, because of their own self-generated heat, they would gradually sink. This would result in absolute containment, good cooling and adequate shielding for the necessary future centuries.

For the many other countries of the world where nuclear power will be such a blessing, no such ready-made national disposal areas exist. There is, however, one international area that is at present next to useless and a portion of it could easily be set aside as a disposal area for the radioactive wastes of the world. This is the antarctic continent.

With a very little stretching of the imagination one can visualise the day when the world's radioactive wastes will be transported to McMurdo Sound or the Weddell Sea by nuclear-powered submarines, travelling comfortably under the ice and storms of the roaring forties, the furious fifties and the sizzling sixties. These radioactive wastes could then be transported from the submarines to the polar ice cap by helicopters (or other types of VTOL aircraft) and simply deposited thereon. Their own self-generated heat and the gradual accumulation of snow and ice over them would provide the required containment, shielding and cooling for the necessary hundreds of years. All this is possible without spoiling the antarctic as a meteorological laboratory and a place of high adventure.

And perhaps more important than anything else, the use of the antarctic for this and other purposes will continue to provide, for all the countries of the world, a very important and useful exercise in international cooperation.

Yours sincerely,
WINNETT BOYD.

720 Marin Avenue,
Montreal 30, Canada.
16 December, 1959.

Events in Advance

Electronics and Control

Nearly 20 papers are due to be presented for discussion at the three-day symposium on "Recent Mechanical Engineering Developments in Automatic Control," which has been arranged by the Institution of Mechanical Engineers and opens at the Institution's headquarters on 5 January. In addition to those of a general character, there will be papers on techniques and components, as well as on the various systems of automatic control and their applications. A James Clayton lecture, "On Automatic Control," will be delivered by Dr. J. A. Hrones at 6 p.m. on 6 January and technical sessions for the presentation of the other papers will take place on the morning and afternoon of 6 January and on the morning of 7 January. Visits to places of interest have been arranged for the afternoon of 7 January.

In Washington, DC, the United States national symposium on "Reliability and Quality Control in Electronics" will be held at the Statler Hilton Hotel from 11 to 13 January. Very considerable success has attended previous symposia under this banner and the present event is the sixth of the series. Mr. R. Brewer, of the General Electric Company's research laboratories, Wembley, has served as publicity chairman for the United Kingdom and has been largely responsible for making arrangements in this country on behalf of the symposium.

The Physical Society's five-day Exhibition of Scientific Instruments and Apparatus opens at the Royal Horticultural Society's Halls, London, on 18 January. The instruments and apparatus to be displayed have, generally speaking, been designed to cater for a wide range of requirements in both science and engineering, and represent some of the latest achievements in these fields. Viewed as a whole, the exhibits will reflect the continually-increasing importance of the various branches of science, such as radio and electronic engineering, and of the techniques

involving X-rays and radioactivity. Other departments of scientific knowledge, however, will also be well represented.

Exhibitions and Conferences

Boat Show, Sixth National.—Now current. Closes on Sat., 9 Jan. At Earl's Court, London, SW5. Organised by the Ship and Boat Builders' National Federation, 23 Knightsbridge, London, SW1. Tel. BELgravia 6402.

"Model Engineer" Exhibition.—Now current. Closes on Sat., 9 Jan. At the Royal Horticultural Society's New Hall, Greycoat Street, London, SW1. Organised by *The Model Engineer* (Percival Marshall and Co., Ltd.), 19-20 Noel Street, London, W1. Tel. GERrard 8811.

Racing Car Show.—Sat., 2 Jan., to Sat., 9 Jan., at the Royal Horticultural Society's Old Hall, Vincent Square, London, SW1.

Camping and Outdoor Life Exhibition.—Sat., 2 Jan., to Sat., 9 Jan., at Olympia, London, W14. Organised by New Homes and Trades Exhibitions, Ltd., Exhibition House, Spring Street, London, W2. Tel. AMBassador 5421.

Recent Mechanical Engineering Developments in Automatic Control, Symposium.—Tues., 5 Jan., to Thurs., 7 Jan., at 1 Birdcage Walk, London, SW1. Organised by the Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. Tel. WHItehall 7476.

Schoolboys' Own Exhibition, National.—Tues., 5 Jan., to Sat., 9 Jan., at Olympia, London, W14.

Toy Fair, 11th International.—Sat., 9 Jan., to Fri., 15 Jan., at Harrogate. Organised by Harrogate International Toy Fair Ltd., Finsbury Court, Finsbury Pavement, London, EC2. Tel. MONarch 8921.

Electronics, Sixth National Symposium on Reliability and Quality Control in.—Mon., 11 Jan., to Wed., 13 Jan., at the Statler Hilton Hotel, Washington, DC, USA. Information obtainable from Mr. R. Brewer, Research Laboratories, General Electric Co., Ltd., Wembley, Middlesex. Tel. Arnold 1262.

"War on Want," International Exhibition.—Sat., 16 Jan., to Sat., 23 Jan., at the Central Hall, Westminster, London, SW1.

Motor, Motor Cycle and Cycle Exhibition, Brussels International.—Sat., 16 Jan., to Wed., 27 Jan., in Brussels. Organised by the Salon de l'Automobile et du Cycle, 22 Rue du Luxembourg, Brussels 4, Belgium.

Physical Society's Exhibition of Scientific Instruments and Apparatus.—Mon., 18 Jan., to Fri., 22 Jan., at the Royal Horticultural Society's Old and New Halls, Vincent Square and Greycoat Street, London, SW1. Organised by the Physical Society, 1 Lowther Gardens, Prince Consort Road, London, SW7. Tel. KENsington 0048.

Hotel and Catering Exhibition, International.—Tues., 19 Jan., to Thurs., 28 Jan., at Olympia, London, W14. Organised by the Hotel and Catering Exhibition (London) Ltd., 623 Grand Buildings, Trafalgar Square, London, WC2. Tel. WHItehall 1371.

British Toy Fair.—Mon., 15 Feb., to Fri., 19 Feb., at Brighton. Organised by the British Toy Manufacturers Association, 93-94 Hatton Garden, London, EC1. Tel. CHAncery 9158.

Packaging Machines, Confectionery Machines and Packaging Materials, Second International Exhibition (INTERPACK).—Wed., 20 April, to Wed., 27 April, at Dusseldorf. Applications to the Packaging Centre, 50 Poland Street, London, W1. (Tel. REGent 7781); or to John E. Buck and Co., Ltd., 47 Brewer Street, London, W1. Tel. GERrard 7576.

Design Engineering Show.—Mon., 23 May, to Thurs., 26 May, at the Coliseum, New York. Apply to Clapp and Poliak, Inc., 341 Madison Avenue, New York 17.

Machine Tool Exhibition, International.—Sat., 25 June, to Fri., 8 July, at Olympia, London, W14. Organised by the Machine Tool Trades Association, Brettenham House, Lancaster Place, London, WC2. Tel. TEMple Bar 3606.

Canadian National Material Handling Show and Conference.—Mon., 3 Oct., to Fri., 7 Oct., at the Show Mart, Montreal. Offices: PO Box 43, Notre Dame de Grace, Montreal, Canada.

Metallic Corrosion, First International Congress on.—Mon., 10 April, to Sat., 15 April, 1961, in South Kensington, London, SW7. Apply to Lieut.-Col. F. J. Griffin, hon. secretary of the congress, at 14 Belgrave Square, London, SW1.

Nuclear Development: Impact on Electricity Supply and on Instrument Techniques, Convention.—In September, 1961, in London. Organised by the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. Tel. COVent Garden 1871.

Federation Internationale de la Precontrainte, Fourth Congress.—In June or July, 1962, in Rome and Naples. Offices: 6 Rue Paul Valéry, Paris 16e; and Terminal House, Grosvenor Gardens, London, SW1. Tel. BELgravia 6661.

Meetings and Papers

Antiquarian Horological Society

LONDON
"Bells and Bell Founding," by Douglas Hughes. Science Museum, Exhibition Road, SW7. Fri., 8 Jan., 7 p.m.

British Institution of Radio Engineers

LONDON
"New Possibilities in Civil Underwater Echo-Ranging-Current Research at the University of Birmingham," by Professor D. G. Tucker. Radar Group. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 6 Jan., 6.30 p.m.*

Chemical Society

BRISTOL
"Radiochemical Analysis," by Dr. J. N. Andrews. Bristol Branch. College of Technology, Ashley Down, Bristol 7. Fri., 8 Jan., 6.30 p.m.

Helicopter Association

LONDON
"Development and Flight Testing of Helicopters," by G. J. Sarsted and A. V. Coles. Royal Aeronautical Society, 4 Hamilton Place, W1. Fri., 8 Jan., 6 p.m.

Institute of Fuel

MAIDSTONE
"Nuclear Power," by N. D. Norris; and film "How a Thermal Reactor Works." South East Section. Dunning Hall, Week Street, Maidstone. Fri., 8 Jan., 7 p.m.

Institute of Petroleum

LONDON
"Flow Properties of Admiralty Fuel Oils." Symposium by members of the Fuel Oil Pumpability Panel of the Admiralty Fuels and Lubricants Advisory Committee. Wed., 6 Jan., 2.30 p.m. and 5.30 p.m.*

Institute of Physics

LONDON
"Problem of Primary Cosmic Radiation," by Professor J. G. Wilson. London and Home Counties Branch. Mon., 4 Jan., 6 p.m.

Institute of Refrigeration

LONDON
"Lubricating Problems of Refrigerating Machines Using Refrigerant 12," by H. Heckmatt. Institute of Marine Engineers, Memorial Building, 76 Mark Lane, EC3. Thurs., 7 Jan., 5.30 p.m.*

Institute of Road Transport Engineers

NOTTINGHAM
"Design and Construction of the Routemaster Bus," by A. G. Higgins. East Midlands Centre. Mechanics' Institute, Nottingham. Tues., 5 Jan., 6.30 p.m.

Institute of Wood Science

LONDON
"Nature and Function of the Cambium," by Professor A. R. Gemmell. Imperial College, Exhibition Road, South Kensington, SW7. Tues., 5 Jan., 6.45 p.m.*

Institution of British Agricultural Engineers

BIRMINGHAM
"Forage Harvester and Work Study in Relation to Silage Making and Feeding," by F. S. Mitchell and N. W. Dilke. West Midlands Centre. College of Technology, Gosta Green, Birmingham. Mon., 4 Jan., 7.30 p.m.

Institution of Chemical Engineers

LONDON
"Heat Transfer to Two-Phase Gas/Liquid Systems"—Part 1, by J. A. R. Bennett, J. G. Collier, H. R. C. Pratt and J. D. Thornton; and "Pressure Drop and Hold-up in Two-Phase Flow," by J. G. Collier, J. D. Thorton and J. A. R. Bennett. Geological Society, Burlington House, Piccadilly, W1. Tues., 5 Jan., 5.30 p.m.*

Institution of Civil Engineers

LONDON
"Dredging Equipment," by Captain H. R. Cooper. Dugald Clerk Lecture. Wed., 6 Jan., 6.30 p.m.*

Institution of Civil Engineers of Ireland

DUBLIN
"Ferro-Cement," by L. D. G. Collen. Mon., 4 Jan., 6.15 p.m.*

Institution of Electrical Engineers

LONDON
"A New Method for Observing the Phenomena of Commutation," by H. J. H. Sketch, P. A. Shaw and R. J. K. Splatt; and "A Method of Measuring Self-Inductances Applicable to Large Electrical Machines," by Professor J. C. Prescott and A. K. El-Kharashi. Joint Meeting of the Measurement, Supply and Utilization Sections. Tues., 5 Jan., 5.30 p.m.*
"Protection of Electrical Systems," by H. G. Bell. Second Hunter Memorial Lecture. Thurs., 7 Jan., 5.30 p.m.*
"Electrical and Electronic Techniques in Respiratory Research." Discussion opened by Professor R. Woolmer and D. W. Hill. Medical Electronics Discussion Group. Fri., 8 Jan., 6 p.m.*

Institution of Engineering Designers

BIRMINGHAM
"Measuring and Gauging Equipment," by T. Ellerby. Midlands Branch. Queen's Hotel, Birmingham. Wed., 6 Jan., 7 p.m.

Institution of Heating and Ventilating Engineers

LONDON
"High Velocity Air Conditioning," by J. K. W. MacVicker. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Thurs., 7 Jan., 6 p.m.*

Institution of Highway Engineers

NORWICH
Film Display and Open Discussion Meeting. East Anglian Branch. Assembly House, Theatre Street, Norwich. Wed., 6 Jan., 6.45 p.m.

Institution of Mechanical Engineers

LOUGHBOROUGH
"Design by Analogy," by J. O'N. Fisher. East Midlands Branch. College of Further Education, Loughborough. Wed., 6 Jan., 7 p.m.

NEWCASTLE UPON TYNE
"Atomic Energy Factories: Design and Construction Problems," by H. V. Disney, to be read by H. Norris. North Eastern Branch. Neville Hall, Westgate Road, Newcastle upon Tyne. Mon., 4 Jan., 6 p.m.

Institution of Naval Architects

LONDON
"'Brave' Class Gas-Turbine Fast Patrol Boats," by J. T. Revans and Commander A. A. C. Gentry. Thurs., 7 Jan., 4.45 p.m.

Institution of Plant Engineers

LONDON
"Water Supply to the City of Manchester: Haweswater Scheme." Discussion. Royal Society of Arts, John Adam Street, WC2. Tues., 5 Jan., 7 p.m.

Junior Institution of Engineers

LONDON
"Coastal Shipping," by Henry Higgs. Fri., 8 Jan., 7 p.m.*

Newcomen Society

LONDON
"Coalbrookdale Group Horsehay Works: Part 2," by Dr. R. A. Mott. Wed., 6 Jan., 5.30 p.m.

Reinforced Concrete Association

LONDON
"Vibration Control in Machine Foundations," by J. H. A. Crockett. Institution of Structural Engineers, 11 Upper Belgrave Street, SW1. Wed., 6 Jan., 6 p.m.*

Royal Aeronautical Society

LONDON
"Flying and the Human Machine," by Dr. G. Melvill Jones. Juvenile Lecture. Royal Society of Arts, John Adam Street, WC2. Thurs., 7 Jan., 3 p.m.

Royal Institution

LONDON
"Release and Use of Atomic Energy." Course of lectures for a juvenile auditory, by Dr. T. E. Allibone. Sat., 2 Jan.; Tues., 5 Jan.; Thurs., 7 Jan.; and Sat., 9 Jan.; all at 3 p.m.

Royal Meteorological Society

LONDON
"Mountain Waves," by C. E. Wallington. Wed., 6 Jan., 5.30 p.m.*

Sheffield Metallurgical Association

SHEFFIELD
Annual General Meeting of the Methods of Analysis Group. Presidential Address by the new chairman. BISRA Laboratories, Hoyle Street, Sheffield. Tues., 5 Jan., 7 p.m.

Society of Instrument Technology

LONDON
"Production and Assimilation of Meteorological Observations," by E. J. Sumner. Data Processing Section. Manson House, 26 Portland Place, W1. Thurs., 7 Jan., 7 p.m.*

BIRMINGHAM
"Control Systems as Applied to Railway Signalling," by J. C. Kubale. Midland Section. Gosta Green College of Technology, Aston Street, Birmingham. Fri., 8 Jan., 7 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

Antiquarian Horological Society. Apply to Mr. E. J. Tyler, 95 Barnfield Avenue, Kingston-on-Thames, Surrey.
British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
Chemical Society, Burlington House, Piccadilly, London, W1. (REGent 0675)
Helicopter Association of Great Britain, 4 The Sanctuary, London, SW1. (ABBey 5160)
Institute of Fuel, 18 Devonshire Street, Portland Place, London, W1. (LANgham 7124)
Institute of Petroleum, 61 New Cavendish Street, London, W1. (LANgham 3583)
Institute of Physics, 47 Belgrave Square, London, SW1. (BELgravia 6111)
Institute of Refrigeration, New Bridge Street House, New Bridge Street, London, EC4. (CENtral 4694)
Institute of Road Transport Engineers, 69 Victoria Street, London, SW1. (ABBey 6248)
Institute of Wood Science, 21 College Hill, London, EC4.
Institution of British Agricultural Engineers, 6 Buckingham Gate, London, SW1. (TATe Gallery 8589)
Institution of Chemical Engineers, 16 Belgrave Square, London, SW1. (BELgravia 3647)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Civil Engineers of Ireland, 35 Dawson Street, Dublin.
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Engineering Designers, 38 Portland Place, London, W1. (LANgham 8847)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Highway Engineers, 47 Victoria Street, London, SW1. (ABBey 3891)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Naval Architects, 10 Upper Belgrave Street, London, SW1. (SLOane 4622)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London, SW1. (VICtoria 0786)
Newcomen Society, Science Museum, Exhibition Road, London, SW7. (KENsington 1793)
Reinforced Concrete Association, 94-98 Petty France, London, SW1. (ABBey 4504)
Royal Aeronautical Society, 4 Hamilton Place, London, W1. (GROsvenor 3515)
Royal Institution, 21 Albemarle Street, London, W1. (HYDe Park 0669)
Royal Meteorological Society, 49 Cromwell Road, South Kensington, London, SW7. (KENsington 0730)
Sheffield Metallurgical Association, 64 Crescent Road, Sheffield 7. (Sheffield 52865)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)

Glu-Lam Timbers for Smaller Buildings

Straight beams of glued-laminated timber are economical for small buildings and aesthetically pleasing. They are readily made and erected.

Glued laminated timber construction came into prominence some years ago with the erection of some remarkable structures, including bridges, aircraft hangars, sports arenas and churches. In North America was this especially the case, where an abundant supply of suitable timbers was combined with a quest to get the most out of the strength of glues and the elasticity of timber. Long spans and curving members of spectacular shapes became, if not commonplace, at least frequently illustrated examples of modern buildings. Among the largest were the laminated timber arch ribs of the Health and Physical Education Centre of the Montana State College in the United States. In this domed building 36 ribs at 10° intervals covered a building of just over 300 ft diameter, rising from a height of 40 ft at the perimeter to 90 ft at the centre.

In this country also laminated timbers have been used principally for curved and tapered members, the most notable perhaps being the large parabolic arches made for the Waterloo entrance to the Festival of Britain on London's South Bank. A number of three-pinned arches have also been similarly fabricated for churches and recently attractive portal frames have been used in the new two-storey sales block for CIBA (A.R.L.) Limited, the adhesives manufacturer at Duxford. These frames—shown in the upper illustration—were laminated with Aerodux 185 and the stanchion branched at the crown to form the main beam inside the building with a short cantilever section outside. Made by Saunders-Roe (Anglesey) Limited, the frames are entirely exposed, forming a major feature of the building.

Straight beams and members of low curvature, however, have not received equal publicity, probably because of their relative simplicity, though they are a good proposition both economically and aesthetically.

In the United States and Canada the use of straight beams of glued laminated softwood has become everyday practice and, in the West especially, a simple post-and-beam architecture, often associated with solid timber roof decking, is providing utilitarian structures which compare favourably in price with steel and concrete buildings. In schools, supermarkets and offices, the beams are usually treated as a decorative feature and are dressed and varnished, but where appearance is of secondary importance as in storage buildings and mills, less attention is given to finish.

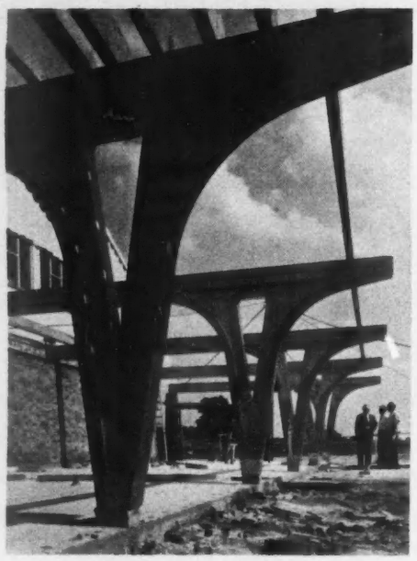
On this side of the Atlantic, the straight laminated beam has only recently come on the scene though a number of timber fabricating concerns have facilities for its production. With few exceptions, orders have been restricted to arches, portal frames and components for bowstring trusses. Light connectored trusses and plywood box beams have generally taken precedence over glu-lam beams, largely on grounds of cost. The plywood box beam, eminently suitable for comparatively short spans, in light modular buildings, has made particularly rapid headway and in single-storey post-and-beam construction, such as for schools, has probably secured much of the market which would otherwise have been open to glu-lam members

The second photograph on this page illustrates a promising application for small straight glu-lam timbers. In a number of larger schools comparatively big laminated beams have been successfully absorbed into traditional brick and timber construction. Other, smaller, school buildings show in a striking manner how glu-lam beams of appreciably smaller section can be used as part of a wholly timber construction, supported by laminated timber posts. These smaller schools, designed on a 6 ft 8 in module, are timber framed throughout and the three-layer 4 in by 4 in glu-lam posts are so assembled that lateral framing members of the wall slot into gaps left in the centre lamination.

Already 800 glu-lam beams have been used in secondary and primary schools so far completed. Contributions to this, the largest glu-lam exercise so far undertaken in Britain, have been made by Laminated Wood Limited, of Bideford, Devon, Gabriel, Wade and English Limited, at their Southampton Works, and Toogood Limited, of Bristol.

Beams for the school programme are now fabricated from a specially imported grade of Canadian Douglas fir selected primarily for glue-laminating requirements. Designs are worked out on bending stresses of 1,800 lb per sq. in and 120 lb per sq. in in shear. These stresses are some way above those recommended in the current British code of practice.

Selected laminations are kiln dried to a moisture content of 12 per cent and on arrival at the Southampton plant are stacked ready for scarfing.



Glu-lam portal frames for the sales office at Duxford of CIBA (A.R.L.).

Scarf cuts are made on a circular sawbench adapted for the purpose and production of scarfed timber is coordinated closely with the requirements of the dry-assembly bay. Laminations are inspected during dry assembly and are positioned according to the stress requirements. From the dry-assembly bay the timber passes to the glue spreader and from that point the glued components are taken to the laminating jigs, set up above a grid floor of wooden slates.

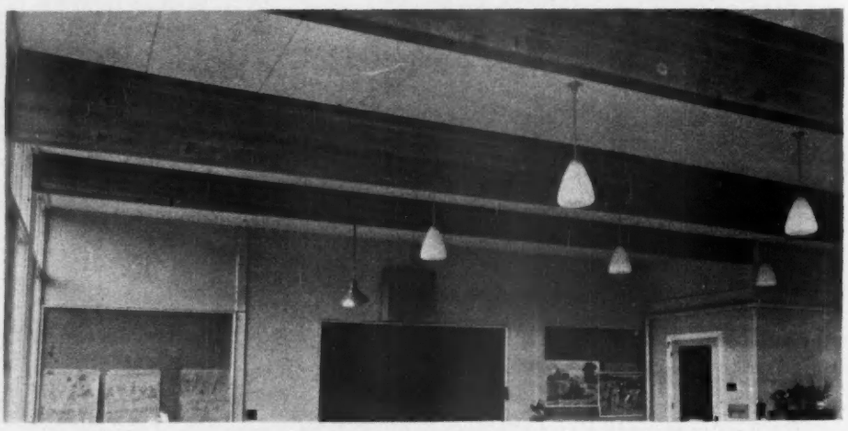
The specification covering all timbers for the school programme stipulates that glue lines should be formed with weather-proof resorcionol adhesive. The adhesive used by Gabriel, Wade is Cascophen RS 240-M, made by Leicester Lovell and Company Limited, Southampton.

Simplicity is the keynote of efficiency in the laminating process. Jigs of L section are bolted down to the raised platform which is heated by waste steam from the adjoining sawmill. Beams are usually formed in pairs one above the other and cramps are tightened with powdered nut-runners. A final glue squeeze-out is obtained with manual ratchet wrenches. The normal work plan at Southampton requires the day's output of cramped beams to be shuttered down and left to cure over night.

Subsequent woodworking operations applied to the rough beams include removal of the glue squeeze-out, planing (and, where necessary, tapering) to final dimensions, and plugging such defects as knots which merit attention. A final sanding may also be specified. When all processes are completed the beam receives a preservative coating of a solution containing pentachlorophenol. It is then wrapped in bitumen coated paper and removed to store.

Effective parcelling is important because beams may be left lying about on the building site for some time before they are installed, though this delay should be reduced as far as possible. Bitumen paper affords good weather protection but, on occasion, black marks which are difficult to erase may appear when the paper is removed in situ. Gabriel, Wade are currently experimenting with a new plastic film which can be brushed or sprayed on to the timbers. This solution sets to form a durable skin in about 20 minutes which can be readily stripped off once the beam is in position in the building.

Handling of glu-lam beams on the building site calls for good supervision if damage is to be avoided, and requires cooperation on the part of the building contractor. However, it is usually found that site teams are quick to appreciate that glu-lam members are easier to handle (because they are lighter) than steelwork and drilling or cutting required on the site can be done with ordinary carpentry tools.



Straight glued-laminated—glu-lam—timbers are economical for small buildings such as offices, laboratories and small factories. Here they are shown used as ceiling members in a school classroom.

Tay Road Bridge Proposals

Consulting engineers for the Tay Road Bridge are to be appointed and plans prepared as soon as possible. The Government have affirmed in discussions with representatives of the city of Dundee their intention to see an early start made on the construction of the bridge.

The proposed bridge will be approximately 7,400 ft long and comprise a number of spans of between 120 ft and 200 ft; there will also be two or three navigation spans towards the south bank of the river, where the width of the waterway will be 240 ft and the minimum clearance 77 ft. The remainder of the bridge will be constructed at a much lower height.

The bridge approach on the north bank of the river will be located in the area of the King William IV Dock and Earl Grey Dock, both of which are to be filled in. This area is immediately adjacent to the central part of the Dundee and adequate access will be provided to the city's main road system.

The bridge is likely to be constructed in reinforced concrete although other materials will be considered before a final design is approved.

Piping Oil from the Sahara

A loan equivalent to $50 million is to be made by the World Bank to speed the completion of the 412 mile oil pipeline from the Hassi Messaoud oilfield in the Sahara to the Algerian port of Bougie on the Mediterranean coast.

Construction of the pipeline was begun in late 1957 and it is already in part operation. The system has at present one 24 in pipeline and two pumping stations; the capacity of the line is now 4·6 million tons of crude oil a year. Installation of more pumps and pumping stations will bring its capacity up to 14 million tons annually during 1961.

The loan is being made to the Société Pétrolière de Gérance, a corporation owned jointly by the two companies producing oil in the Sahara; Société Nationale de Recherche et d'Exploration des Pétroles en Algérie, which is mainly owned by the French Government; and the Compagnie Française des Pétroles (Algérie). Most of the crudes will be taken to France and converted to fuel oil suitable for use in thermal power stations. Much of the Sahara crude oil is a light fraction easily refined for petrols.

Motorways Opened and Proposed

The whole of the route of the Birmingham-Lancaster motorway, 141 miles long, has now been published by the Ministry of Transport. The last two sections, 43 miles in all, were made known during December.

The first of the new proposals covers a 13 mile link between the Lancaster bypass, to be finished next May, and the Preston bypass. South of Preston the line of the motorway as far as Dunston (near Stafford), a distance of 78 miles, was statutorily fixed in June 1958 and work has already started on some of the bridges.

South of Dunston, the route for 30 miles has now been published. It passes between Wolverhampton, West Bromwich and Birmingham on the west and Walsall and Sutton Coldfield on the east; it then swings east to follow the line of the Tame Valley Canal to within 2½ miles of the centre of Birmingham. About 7 miles of this route will be urban motorway in character. Beyond Coleshill, modifications to existing roads will give dual-carriageway connections with the London-Birmingham motorway (M1).

At the London end of M1, the Watford leg, which will be used by most London-bound traffic, has now been opened. This last stretch is 2¼ miles long and has been completed one month ahead of schedule. A rail-mounted concrete train was used by the contractors to lay the road and a British paving record of 1,200 ft of 26 ft wide pavement put down in eleven hours was established. This plant is now idle and awaiting new work. The consortium of contractors on the Watford leg was Holland & Hannen and Cubitts, Fitzpatrick and Sons (Contractors) Limited, and Lehane, Mackenzie and Shand Limited.

For the year ended 31 March last the Ministry of Transport's returns show that £44 million were spent on major road improvements and new construction, against £23 for the previous year.

Auckland Bridge Tolls

The Auckland Harbour Bridge is earning considerably more revenue than was originally expected, even though a generous allowance was made for increase in the city's traffic. Over 10,500 vehicles now use the bridge daily; this is 1,500 more than was the daily estimate for the first year. The bridge was opened in May 1959 and cost £3½ million.

Toll charges on the bridge are: trucks, 4*s* to £1; buses, 5*s*; private cars, 2*s* 6*d*; motorcycles, 1*s* 3*d*.

Despite the objections always put up against new toll routes, it is remarkable how many of them generate more traffic than even their supporters believed possible. This was true before the war when, for example, both the Mersey Tunnel in Liverpool and the Sydney Harbour bridge in Australia drew much more traffic—and revenue—than their sponsors had hoped. Toll roads in the United States before and since the war have not lacked users who have thought it worthwhile buying time. In France, too, the experience has been the same, where the big suspension bridge over the Seine estuary at Tancaville has been carrying more traffic than was thought possible—the first toll route allowed in that country since the Revolution.

Car Parks Over Railways

Consideration is being given to the suggestion that the new Cannon Street railway station in the City of London should be roofed to form a car park for 525 vehicles. The possibility of using it as a helicopter station at some time in the future is also under review. Replanning for car parks is also under consideration at Victoria (for 1,000 vehicles) and London Bridge.

At Richmond in Surrey the council are trying to get permission to roof over the Southern Region main line track west of the station to provide two-tier parking above the lines. As the tracks are well below street level, access to the car park would be direct from the surrounding roads.

Other stations in the London area which have been proposed (with varying degrees of authoritative backing) for modification to provide car parking include Euston and Marylebone. Powerful committees are also suggesting that new car parks should be put under the London parks, with direct passenger connections to the nearby tube railway system.

Welland Canal Contracts

Six contracts valued at over $3,000,000 have been awarded to Canadian firms by the St. Lawrence Seaway Authority for the construction of extensions to the entrance walls in the Welland Canal. The work, which is to be done this winter while the Seaway is closed to shipping, will add 6,000 ft of tie-up walls for ships using the Canal.

Four construction contracts have been awarded as follows: Lock No. 1, Carter Construction Company ($291,540); Lock No. 2, McNamara Marine Limited ($543,180); Lock No. 3, C. A. Pitts General Contractors Limited ($727,466); and Guard gate, McNamara Limited ($547,823). All three companies are based in Toronto.

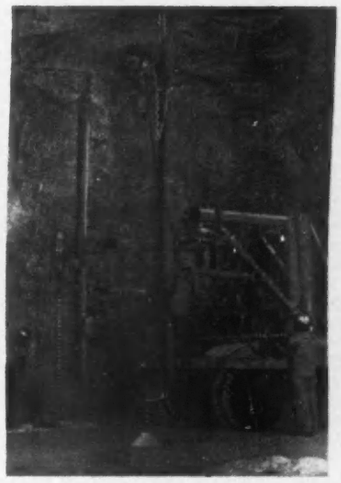
The Authority has arranged to supply the sawn timber and spruce piling to be used by the general contractors by letting a contract for sawn timber to MacMillan and Bloedel Sales (Quebec) Limited and another for spruce piling to Great Lakes Lumber and Shipping Limited of Fort William, Ontario. These contracts for timber exceed $900,000 in value.

The work on the contracts was begun as the Canal was closed and are all due to be completed by 20 April, 1960.

Drill Rig for Salt Mine

Drilling holes in salt has been greatly simplied fied by the truck-mounted rig shown in the illustration. The new equipment has also enabled the amount of explosives to be reduced.

The drill rig, which is being used in the Morton Salt Company's mine at Weeks Island, Louisiana,



This rig runs a hole, 2 in in diameter and 34 ft deep, in pure salt at a rate of 10 ft per minute.

USA, was designed by the Landis Steel Company. It uses threaded sectional augers made by Kennametal Incorporated of Latrobe, Pennsylvania.

Hard carbide drill bits, 2 in in diameter, penetrate to a depth of 34 ft at a rate of 10 ft per minute. Seven 34 ft holes now supersede 120 face drilled horizontal holes 10 ft deep, and allow 900 tons of salt to be broken out using only 60 per cent of the explosives formerly required.

This salt mining operation is carried on 750 ft below ground in a salt column that is at least four miles deep and having a cross-sectional area of three to four square miles. The salt is 99·7 per cent pure NaCl and is used principally in the chemical industry.

Go-ahead for Victoria Tube?

The influential London Travel Committee, which was set up by the Minister of Transport to advise him on London's travelling problems, has recommended that the new Victoria Line (for London Transport's underground railway system) should be given the highest priority. At a cost of £55 million, the committee recognise that the new line could only ever lose money, probably at a rate of £2½ million per annum.

The new railway, which would run north-east from Victoria, through London's west end, would link with both Euston and Kings Cross. The northern terminal is to be at Walthamstow. Construction would take six years from the date of commencement.

Sports Cars and Economics of All Cars

With the opening of the first Racing Car Show tomorrow, many enthusiasts will be tuning their engines and considering conversions. Car running costs are of interest to more drivers than the enthusiast.

Few can afford to have a sports car built to their own specification, but facilities are nowadays available for drivers to assemble a car to their own taste from a comprehensive selection of components. Designed with this in mind, the Alexander-Turner two-seater sports car can assume several roles with the aid of optional extras. It is the direct descendent of the Turner driven by Bob Gerard throughout last season to win the 1959 Autosport Championship.

The glass fibre body is mounted on a subframe of all-welded construction using large-diameter tubes to provide strength and rigidity for good road holding. The independent front suspension employs coil springs using the British Motor Corporation's "A" series main components with Armstrong hydraulic shock absorbers. The rear suspension comprises a BMC "A" series rear axle located on trailing arms with laminated torsion bar suspension, telescopic hydraulic shock absorbers and Panhard rod.

The same series BMC gearbox and engine are fitted, but the engine, which also powers the Sprite, A40 and Minor 1000, has been adapted by Alexander to improve the performance. A light-alloy cross-flow cylinder head has been added giving a compression ratio of 9·4 to 1. There are twin 1¼ in SU carburettors and a special exhaust system. With full conversion, the 950 c.c. engine develops 80 b.h.p., and in the Coupe de Salon at Montlhery propelled an Austin-Healey Sprite at 118 m.p.h., winning its class.

The optional extras, designed to equip the Alexander-Turner for events ranging from club rallies to full-scale sports-car races, include a choice of three camshafts, ZF self-locking differential, Girling front disc brakes, Lockheed servo-assisted braking, wire wheels or standard wheels with knock-on hubs, high-compression pistons, racing-strength close-ratio gears, and detachable hard top. Care has been taken on the car's internal finish and all-weather equipment is fitted. A large rear luggage compartment is incorporated with hinged locking lid. The price of the car complete is given as £895 including purchase tax; but the model is also available in kit form at a price of £645. Table I is a detailed specification.

CONVERSIONS

Motorists wishing to improve the performance of their cars have access nowadays to a wide variety of factory-made conversion components.

TABLE I.—*Specification for the Alexander-Turner Two-Seater Sports Car*

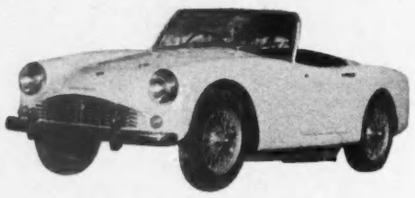
Chassis	
Wheelbase	6 ft 8½ in
Track—Front	3 ft 9½ in
Rear	3 ft 8½ in
Overall length	11 ft 6 in
Overall width	4 ft 6 in
Overall height to windscreen	3 ft 11 in
Brakes	8 in by 1½ in 2LS
Wheel size	15 in
Tyre size	5·20 in by 15 in
Engine	
Bore	62·9 mm
Stroke	76·2 mm
Cubic capacity	948 cc
Maximum b.h.p.	60 at 6,000 r.p.m.
Compression ratio	9·4 to 1
Transmission	
Rear axle ratio	4·55 to 1
Gear ratios—Reverse	4·664
First	3·628
Second	2·374
Third	1·412
Top	1·0
Clutch	6½ in diameter

The Alexander Engineering Company Limited, who make the sports car described above, also produce many optional extras, ranging from special cylinder heads to racing brake linings.

The company have, for instance, designed an overhead-valve cylinder head suitable for all BMC "A" series engines, both in 803 and 950 c.c. versions. The head, which is of crossflow pattern, has four separate inlet ports, transferred to the other side to avoid excessive exhaust heat and thereby improving volumetric efficiency. Wedge shaped fully machined combustion chambers provide good squish (the effect of the piston's upward motion in mixing the fuel and air) for full and part throttle operation. The valve gear is compact and designed to permit higher r.p.m. without valve bounce. The inlets are enlarged by $\frac{1}{16}$ in to 1·25 in and the exhausts by $\frac{1}{16}$ in to 1·06 in. Since exhaust porting is not as vital as inlet porting it has been left more or less standard, but with improved flow to enable the normal exhaust manifold and system to be retained if so desired; alternatively a three-branch system may be used. The head is made from aluminium alloy, which has high thermal conductivity, and permits satisfactory running on premium fuel at 9·5 : 1 compression ratio.

The makers claim after 6 months' testing that not only is performance much improved but also economy, owing to better distribution of the mixture and part throttle combustion. Generally the advantages are said to be: (1) high efficiency of the combustion-chamber shapes; (2) high air flow porting; (3) thermally correct plug positioning; (4) full benefit from increased valve diameters by correct valve location; and (5) improved heat dissipation to the cooling water, owing to the high conductivity of aluminium alloy, and cooler running, so permitting high compression ratios with the same octane fuel and more economical high-speed cruising. Shaping to facilitate water flow around sparking plugs, exhaust valve seats and combustion chamber also contributes to this last effect.

With a Morris Minor 1000, maximum speeds of 85 to 90 m.p.h. have been attained; and acceleration time up to 30 m.p.h. has been reduced from 6·2 to 5·1 sec and up to 60 m.p.h., from 25·9 to 15·6 sec. The price of the complete head with all valve gear, rocker cover, pushrods, inlet manifold and other necessary items, is £85. The cylinder head illustrated is a similar conversion for BMC series "B" engines. It is reported to have shown 25 per cent improvement at 5,000 r.p.m. on the new 1600 MGA engine with standard pistons and camshaft.



The Alexander-Turner two-seater sports car may be modified by a wide choice of optional extras.

Other conversion equipment includes a flexible manifold mounting designed to raise carburettor efficiency. By damping vibration of the carburettor jet and suction chamber the manifold improves airflow and fuel metering. Injection moulded from nitrile rubber, the manifold also prolongs carburettor life and may be fitted to BMC "A" series, Farina "B" series, and the Triumph Herald. Camshaft conversions, racing strength close-ratio gears (1st 2·25, 2nd 1·67, 3rd 1·23 and top 1·0), high-compression pistons, and alternative rear-axle ratios are also available.

WHAT IT COSTS TO RUN A CAR

Although performance is a comparatively minor element in the cost of running a car, annual expenditure may well reflect the technical virtues of the make and model. A table of typical running costs would thus enable any driver to calculate his car's economic handicap. The Royal Automobile Club from time to time draw up a schedule of estimated vehicle running costs based on current prices. They emphasise that the schedule is intended simply as a guide, and that the only reliable method of obtaining an accurate analysis of running costs is by keeping a strict record of expenditure over a given period. The schedule is reproduced below.

It will be seen that in the 3,701 to 4,500 c.c. class depreciation is strikingly low. It happens that many cars falling into this class, though large, are comparatively cheap so that, apart from a correspondingly low amortisation, the resale demand is higher than for very expensive cars. The Rolls-Royce, maintained by a painstaking professional chauffeur, might for quite different reasons be expected to suffer little from depreciation.

TABLE II.—*Estimated Vehicle Running Costs Based on Current Prices (pence per mile)*

Standing charges (pence per mile; 10,000 miles per annum)	Up to 1,100 cc	1,101 to 1,300 cc	1,301 to 1,600 cc	1,601 to 2,300 cc	2,301 to 3,000 cc	3,001 to 3,700 cc	3,701 to 4,500 cc	Over 4,500 cc
(*a*) Tax	0·30	0·30	0·30	0·30	0·30	0·30	0·30	0·30
(*b*) Insurance	0·54	0·54	0·62	0·67	0·92	1·09	1·24	1·81
(*c*) Driving licence	0·006	0·006	0·006	0·006	0·006	0·006	0·006	0·006
(*d*) Depreciation	1·84	1·96	2·20	2·68	3·86	5·47	3·60	15·72
(*e*) Interest on capital	0·36	0·39	0·46	0·54	0·87	1·09	0·72	3·14
(*f*) Garaging	0·62	0·62	0·62	0·62	0·75	0·94	0·94	1·25
(*g*) Subscription (associate) to the RAC	0·05	0·05	0·05	0·05	0·05	0·05	0·05	0·05
10,000 miles per annum	3·716	3·866	4·256	4·866	6·756	8·946	6·856	22·276
5,000 miles per annum	5·61	5·78	6·32	7·06	9·67	12·45	10·13	28·85
15,000 miles per annum	3·134	3·274	3·580	4·214	5·794	7·784	5·774	20·084
20,000 miles per annum	2·783	2·913	3·233	3·773	5·313	7·243	5·233	19·013
Running Costs								
(*h*) Petrol	1·473	1·696	1·930	1·930	2·543	3·110	3·730	3·730
(*i*) Oil	0·054	0·054	0·054	0·081	0·081	0·081	0·081	0·081
(*j*) Tyres	0·324	0·324	0·341	0·391	0·426	0·542	0·664	0·927
(*k*) Servicing	0·470	0·470	0·470	0·620	0·750	0·750	0·940	1·250
(*l*) Repairs and replacements	1·078	1·034	1·144	1·221	1·507	1·694	1·485	2·586
Total cost per mile (10,000 miles per annum)	3·399	3·578	3·939	4·243	5·307	6·177	6·900	8·574
Standing charges	3·716	3·866	4·256	4·866	6·756	8·946	6·856	22·276
Running costs (10,000 miles per annum)	3·399	3·578	3·939	4·243	5·307	6·177	6·900	8·574
	7·115	7·444	8·195	9·109	12·063	15·123	13·756	30·850

Assumptions: road fund tax £12 10*s* 0*d* per annum for all cars; insurance calculated on average tariff rates class 1 district C; driving licence 5*s* per annum; depreciation figures based on average new car prices and assume an economical life of 80,000 miles at 10,000 miles per annum; interest on capital calculated on new car prices if invested at 2½ per cent; garaging based on average charges throughout the country according to size of car; associate subscription to RAC £2 2*s* 0*d* per annum; petrol 4*s* 8*d* per gallon; oil based on average consumption throughout life of car; tyre life estimated at 20,000 miles; servicing every 500 miles; repairs and replacement figures based on total cost over economical life of car.

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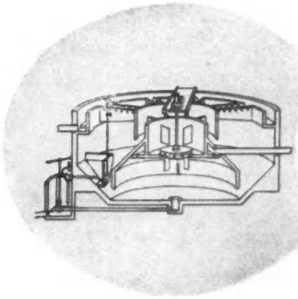

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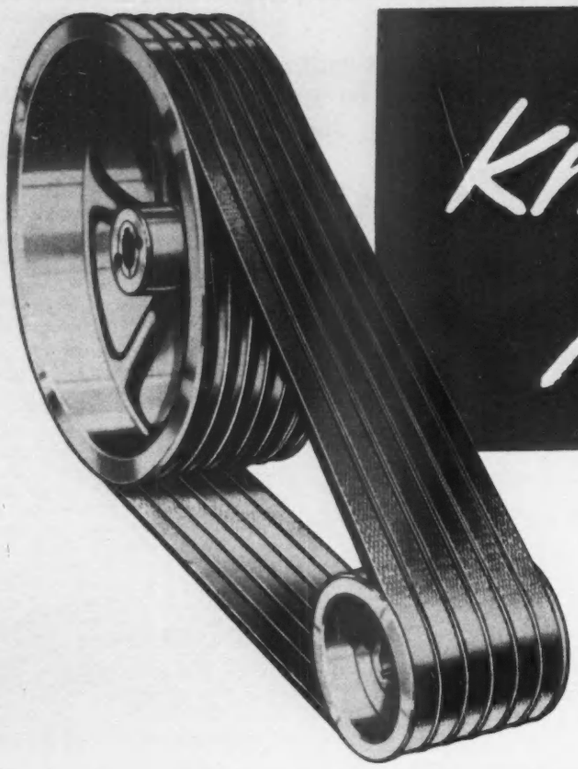

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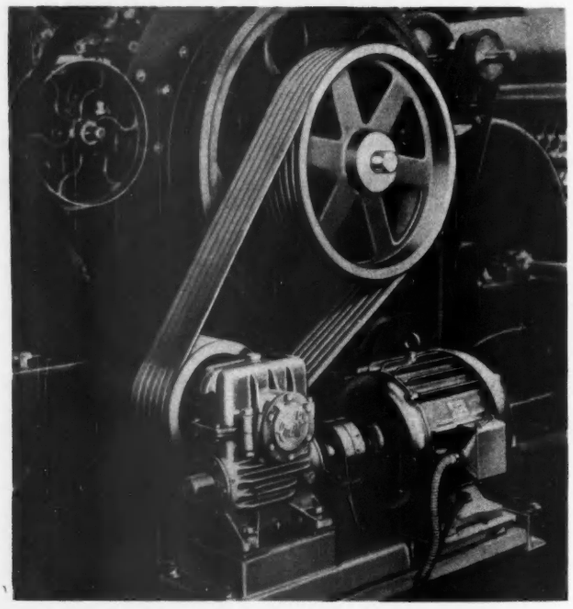

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☐ *Publication 5761*—Taper-Bored V-Rope Pulleys, with Patent Taper-Flushbush

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BRANCHES AT: Belfast, Birmingham, Bristol, Cardiff, Dublin, Glasgow, Ipswich, Leeds, Liverpool, London, Manchester, Newcastle, Northampton, Nottingham, Sheffield, Stoke-on-Trent. Subsidiary Companies in Canada, South Africa, U.S.A. World-wide Representation.

Human Element

Education in Oxygen

The unobtrusive business of industry educating its own people and students from overseas is exemplified by the record of British Oxygen Gases who last year had 600 technical and student visitors to their sales technical services department at Cricklewood in north London. Personnel from the department went out to 250 customers and work samples from 100 clients were received and analysed.

These services, largely demonstration in character, were shared with visitors from Malaya, Ghana, India, East Africa, Iran, Venezuela, Aden, Persia, Israel and Denmark.

British Oxygen Gases also maintains a school for welders at Cricklewood and 800 welding students passed through it in 1959. There are courses from eight weeks of a general and maintenance syllabus to two weeks instruction on light gauge sheet and tube. Some of the 13 instructors are qualified to act as examiners for the association of heating, ventilating and domestic engineer employers. London County Council teachers, and Central Electricity Authority and United Kingdom Atomic Energy Authority and Ministry of Supply officials have been among the students.

Wellcome Foundation Chief Engineer

Mr. R. C. de B. Devereux has been appointed chief engineer of the Wellcome Foundation.

Educated at Repton and Emmanuel College, Cambridge, 31 year-old Mr. Devereux combined law with the mechanical sciences and took honours in both tripos. In 1953 he transferred from Heinz to the Wellcome Foundation as engineer to the pharmaceutical division, Dartford.

Thoroughness in Safety

The well-earned reputation of the iron and steel industry for systematic work on accident prevention under the guidance of the British Iron and Steel Federation has been taken a stage further in the federation's latest publication called *Accident Prevention in Hand Rolling Mills in the Iron and Steel Industry*. Accident hazards vary very much as between one industry and another but the Federation's latest booklet is to be commended as a serious and systematic publicity job. The booklet is well produced and analysis is followed by practical hints and photographic illustrations which are well worth examination beyond the iron and steel industry.

In 1956 the Accident Prevention Committee of the Federation became aware that the accident rate at hand mills was high and a sub-committee was appointed to find out why. This publication is their report. The general conclusions are that top management must be accident conscious, that most accidents in hand mills occur through lack of proper training of operatives and bad placing; through untidyness, bad maintenance, poor guards and bad protective clothing and unwillingness to wear it.

Accidents vary as to cause in different works and each works should keep records. Trade union cooperation is considered important and an active safety committee is a big asset.

£1,000 Award

The Joseph Lucas motor accessory firm has a record of freedom from the industrial disputes that have plagued the motor industry that may reasonably be envied by other firms in the Midlands and along the Thames.

Just how they do it is to be read in detail in a book on their industrial relations—*People and Productivity*—by the chairman of Lucas, Mr. A. B. Waring.

Only last month the firm paid out £1,000 for a suggestion from an employee on the improvement of the automatic self-cancelling device in traffic indicators. "It may sound generous but it was well worth it from the firm's point of view," was Mr. Waring's comment, though he need hardly have used the *but*.

Such an award has an obvious part to play in spurring on the most constructive kind of cooperation and, taken with an enlightened policy, little room should be left for the irresponsible type of shop-floor leader that in other and not always larger firms is on occasion so easily able to mislead large numbers of men.

Education at 6 A.M.

American television is principally known in Britain as a continuous fusillade of six-gun shots, interrupted at frequent intervals by detergent commercials.

But while the great majority of this country's population are still asleep at 6.30 a.m. millions of Americans study with pre-breakfast television educational programmes—"Sunrise Semester" is one network's name for it.

Six o'clock in the morning is not a time known to the traditional pattern of European education, with its midnight oil associations, but more than 300 United States colleges and universities have accredited the National Broadcasting Company's "Continental Classroom." It carries courses in "Atomic Age Physics" and chemistry which are designed to fit in with the work of high school science teachers.

Sociology, history and the fine arts have been added to the syllabus as public interest has grown. An early programme of elementary Russian in the Spring of 1959 put out by the George Washington university is now being followed up by an intermediate Russian course for those who completed the elementary lessons.

300 Schools

Closed-circuit television for instructional purposes is in use at 300 schools and colleges and 21 military bases. At the famous Walter Reed medical centre, in Washington, there are three channels piping lectures and demonstrations not only around its own buildings but to medical conferences in New York.

What is thought to be the largest military closed circuit television instructional system is at the US Army Signal School, at Fort Monmouth, New Jersey. With a seven-channel system the school employs 468 receivers for instruction courses and other training material. No less than 35 receivers are in the base hospital to that patients who are well enough can keep up with their class-work.

A Ford foundation survey showed that over more than 100 public school ETV systems television using students did better in 68 out of 110 comparisons. At Washington university 46 per cent of the television students reached A or B grades in elementary mathematics. Of those not taking ETV classes only 30 per cent made A or B grades in elementary mathematics.

Only the Best

This American achievement is an outstanding example of using a modern communications technique to take education to the handicapped who cannot leave their homes, to workers before they leave for factory or office, to pupils in rural areas who otherwise would not have the best teachers, to hospitals, and to any inquiring mind that cares to get up early.

Quite apart from early morning programmes by the big networks there are 44 non-commercial educational stations in the United States and 12 being built. With 15,000,000 regular viewers watching educational television (ETV) it is believed that the potential audience is of the order of 70,000,000, against a school enrolment in the United States of less than two-thirds of that figure.

Persuasion and Bank Holidays

There has been a revival recently of the discussion about the extension of Summer Time and the possibility of changing to later in the year the Bank Holiday that at present falls on the first Monday of August. This has coincided with a renewal of the complaint—quite justified, as any parent of schoolchildren will agree—about the inconveniences of the peak August holiday period.

What would any change in the traditional summer holiday practices of industry mean in terms of production and also of benefit to the employees to whom a holiday should be an annual time of refreshment? What is the attitude of the educational authorities, whose proclamation of university vacations and school holidays determines the choice of holiday time of a very high proportion of the population?

These are just two of the issues discussed at a topical conference held recently by the Industrial Welfare Society. The object was to hold an exploratory discussion among industrial executives about the possibility of changing established holiday practice. After all, holiday pay equals about 6 per cent of the wage and salary bill of most industrial firms, so managements wish to be certain that this heavy outlay is being used to the maximum benefit of the employee and of the concern as a whole.

The conference concluded that the initiative for any change lies with the individual, with the holiday-maker himself. The travel and hotel trade needs no persuasion that a spreading of the peak holiday period would be desirable. It is up to the employee to bring pressure to bear on the employer to make a change.

Shut Down

Admittedly, staggered holidays are already accepted in many concerns. Equally, it is obviously desirable in certain industries to have a complete shut-down of the plant rather than a shortage of key skilled staff over a period of two or three months. Also a complete shutdown for a week can be extremely useful for maintenance work, and for the installation of new plant. There are many firms and indeed whole industries in which the tradition of an annual holiday week or fortnight has little justification in the face of the crowded transport, high prices and overbooked accommodation that face workpeople in need of peace and relaxation.

It should not be too difficult for the travel trade to persuade the holiday-maker that he can have a more comfortable and perhaps cheaper holiday away from the peak August period. It may well be much harder for the employee to convince his boss that a change in traditional practice could be beneficial to all concerned.

Most difficult of all, it seems, is the problem of convincing the academic world that there is a pressing social need for a change in its established ways. Employers' associations, trade unions, the government itself—all would obviously need to take a hand here.

Still, an amendment of the Bank Holiday Act of 1871 to shift the August Bank Holiday to the end of the month would be a simple way of easing the crush.

Security Without Tears

The United Nations and its various ancillary organisations have played a large part since the war in bringing not only financial and technical assistance to backward areas but also in bringing them into line with the latest western thought on social policy. This is brought out in a booklet in the series of the Institute of Social Studies publications on social change called *The Historical Development of Social Policy*, by Mr. Maurice Milhaud.

It claims rather more for the United Nations than many would be prepared to grant in social matters. The UN has acted as a clearing house for ideas to be disseminated in backward areas. Contrary to what the pamphlet claims, it has not been at the forefront in the development of economic ideas behind social policy. For example, the idea that full employment is an accepted means to social ends and that a man is entitled to uninterrupted employment is not generally accepted. Full employment does not mean sanctity of employment.

These are matters, however, on which the more industrialised countries can be left to argue about. In some backward areas these are perhaps over-subtle issues. No one will quarrel with the claim that the UN has brought the lowest and crudest thinking on social policy closer to the highest and best.

Filling Five Million Glasses a Day

Drinking people will know that Dublin's famous brewery has recently celebrated its second centenary. They may also recall that brewing is an engineering process. The brew of Arthur Guinness Son and Company does great credit to engineers.

By G. W. Barton, A.M.I.Mech.E.

Park Royal Brewery, Arthur Guinness Son and Company Limited

As many readers will be aware Arthur Guinness Son and Company Limited have just completed a double century of brewing. Brewing can be said to be a branch of chemical engineering, and although it is a batch process which has remained virtually unchanged over the centuries, the development of the Guinness company is of special interest as an outstanding example of successful bulk production of a single product.

Mr. Arthur Guinness, the founder of the firm, had been a brewery owner for three years before he obtained the lease of the St. James's Gate, Dublin, brewery in 1759, at that time covering about one acre. The deed of conveyance dated 31 December, 1759, listed the following brewhouse plant: 1 kieve (mash tun); 1 underback; 1 copper containing 70 barrels; 1 horse mill; 1 hopper; and 1 pair of stones.

By the end of the 18th century the annual output was about 10,000 barrels (of 36 gallons) which was but a small fraction of that produced by many London brewers.

The brewery was enlarged early in the 19th century and a description of it published in 1838 stated: "The range of buildings covers nearly four acres; the arrangement and machinery are upon the most complete and efficient plan, and every department is so systematic and well-managed, that the work proceeds with the utmost precision and regularity; no confusion, bustle, nor disorder ensues; the grain is taken up, and weighed in its passage to the lofts, by ingenious mechanical contrivances. There are three mash tuns capable of mashing 600 barrels of malt at a brewing, with three coppers containing 2,040 barrels. The mashing is performed by rakes worked by steam engines, of which there are two of fifteen horse-power that work all the machinery on the premises." In 1850 the annual output was about 100,000 barrels and in 1882 it reached 1,000,000 barrels. At the end of the century, the St. James's Gate brewery was the largest in the world and by 1914 the output had risen to about 3,000,000 barrels per year.

The original ancestor of the Guinness known the world over today, was a dark coloured beer brewed in London about 1722, which it is recorded, had the flavour and general qualities of a mixture of heavy sweet ale and a lighter bitter beer. This beer was particularly favoured by porters and it became known as Porter.

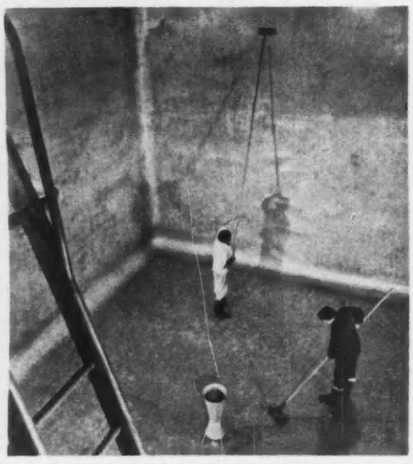
The principal malt liquor sold in Dublin at this time was a brown ale, although some Irish brewers were producing Porter. The brewing of ale at St. James's Gate ceased in 1799 and since then the company has concentrated on the production of stout, the varieties being Porter, chiefly for the Irish market, Extra Superior Porter principally for sale in Britain, and West Indies Porter, which was the forerunner of the present Export and Foreign Extra Stouts.

The business was incorporated as a public company in 1886, with an issued capital of £6 million. In 1908 the ordinary capital was doubled by capitalisation of reserves and subsequent bonus issues have raised the ordinary capital to the present figure of £12½ million. It is remarkable that all the developments within and the expansion of the company, since its incorporation, have been financed without recourse to public issues or calling on outside sources (even the construction of the brewery at Park Royal, London, in 1932-36 was financed from reserves) as a result of the company's traditional policy of ploughing back the profits that have accrued.

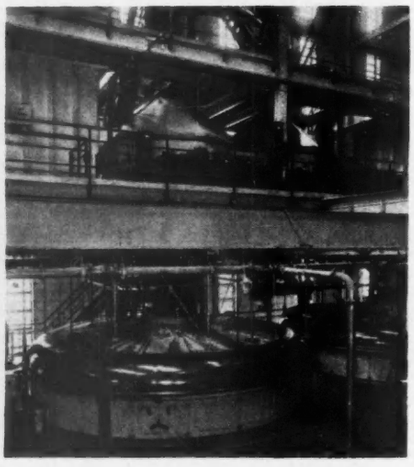
The company has always concentrated on producing in bulk and distributing on a national scale. It has no public houses of its own (these normally make up the greater part of the capital assets of a brewery company) so that in terms of capital assets it is not the largest brewing company. But in terms of output it is by far the largest in the British Isles, the current production of about 3 million barrels being very considerably greater than that of the next largest company.

Many of the slogans forming part of Guinness advertising (for example, "Guinness is good for you" and "Nothing like a Guinness") were household words long before the company began advertising. It will surprise many to be reminded that there was virtually no Guinness advertising in the British Isles before 1929 since when the zoo-keeper ("My Goodness, my Guinness!") and the various strong arm feats, the man carrying the girder probably being the best remembered ("Guinness for Strength"), have added to these household words.

The consumption of Guinness in Britain had risen to such an extent, that during the late 1920's, it was decided to build a brewery in England to brew solely for the British market. Accordingly plans were prepared and work started on the Park Royal Brewery in 1932. It was built on a new and extensive site where the various buildings and plant could be arranged in the most suitable positions relative to one another and the improvements in technique suggested by 175 years' experience of brewing in Dublin were incorporated. Brewing at Park Royal started in 1936 and although over 1,000,000 barrels per year are now produced there, it remains necessary for the Dublin brewery to supply some parts of Britain, the stout being imported, chiefly in 14 barrel stainless steel and aluminium tanks carried in the company's own refrigerated ships.



Cleaning out the interior of an aluminium lined fermenting tun, showing air rouser.



Upper part of a kieve or mash tun with driving gear and grist hopper above.

Turning now to the brewing process and plant, it should be stated that the heart of a brewery is the kieve or mash tun. In this malt gives up its goodness to hot water to form wort and on it the output of a brewery depends. Starting with one wooden mash tun in 1759, the number in the Dublin brewery increased to 24 by 1917, each of sectional cast iron and 20 ft diameter by 7 ft deep. Some of these were driven by steam engine through line shafting until 1948, when the changeover to individual electric drives was completed.

Malt, the principal raw material used in brewing, was manhandled in sacks in 1759, but by 1865, basket elevators, worm conveyors and screens were in use and the malt was stored in bins consisting of masonry walls with wooden partitions held together by tie rods. In 1888, the malt store consisted of 126 brick built octagonal bins each 14 ft wide by 66 ft deep, the total capacity being 250,000 barrels of malt (1 barrel of malt weighs 168 lb). Deliveries were made by barge, horse cart and by railway tip wagon. The Park Royal malt store has reinforced concrete silos 12 ft in diameter by 65 ft deep. They were among the first to be built in England using moving forms with the continuous pouring of concrete. The silos were completed in 13 days the average speed of erection being 5 ft per day. The malt arrives at Park Royal in bulk in road and rail tank wagons, this method eliminating manhandling, labour being required only to supervise the plant.

The wort extracted in the mash tuns passes to coppers in which it is boiled with hops to become hopped wort. Contrary to popular belief hops add nothing to the strength of beer and stout. The first copper was of 70 barrels capacity whereas the size adopted as standard from 1860 onwards was 650 barrels. By 1925 there were 19 of these in use in the Dublin Brewery. Development of these vessels was chiefly concerned with the method of heating. The first coppers were hand fired, three furnaces being necessary to heat the large ones. In 1863 the first mechanically operated chain grate furnace was installed and all coppers were similarly fired soon after 1877. As a rapid boil was needed and flue temperatures were high. In order to reduce these and at the same time recover heat, water cooling was introduced on the furnace bridges and chimneys. The cooling water subsequently being used for brewing. Chains attached to rotating arms were used to keep the hops in suspension and so prevent them from being burnt by the hot floor of the copper.

Low-pressure steam heating was tried without success in 1875, but in the early 1930's it was developed and is now the standard method.

The resulting lower vessel temperatures render the drag chains unnecessary and as the company generates its own electricity, a substantial saving in fuel is made.

Hopbacks containing strainer plates continue to receive the mixture of wort and hops from the coppers but improvements in the methods of disposal of the hops and of the spent grains from the mash tuns, proved possible. The traditional practice is to shovel out the spent materials (there are about 20 tons of spent grain in each mash tun) into tip wagons below the vessels but tests proved pumping away to be practicable, so this method was adopted at Park Royal, with a saving in time and labour.

The hopped wort is pumped to tuns where yeast is added and fermentation begins. The original tuns were of English oak and rectangular in shape, but from 1900 New Zealand Kauri pine was used. Since 1950 all tuns have been either lined with almost pure aluminium or replaced in stainless steel. The size too has increased from about 600 barrels capacity in the very early days, to the present largest tun which holds 8,000 barrels. Mixing in a tun was achieved by a wooden "horse" (consisting of about 1 sq. yd of wood at the end of a 20 ft pole) wielded back and forth by a strong pair of arms. This rather primitive method was replaced at Park Royal by a line of electrically driven paddles, which in turn were superseded by air blown through a venturi tube.

In 1890 carbon dioxide from the tuns was collected, compressed, liquefied and bottled, but this practice ceased in 1902, as it was found to be uneconomic. It was revived from 1941 to 1948 and has continued in Dublin since 1957. At other times the vast quantities of carbon dioxide which are produced during fermentation (62 tons per day in 1936) were, after dilution with air, blown to atmosphere by fans.

After fermentation most of the yeast (which has reproduced itself many times) is skimmed off and it is necessary to separate it from the stout it holds. Since 1880 this has been carried out in plate-type filter presses but in 1865, "Wallers Patent Filters" were in use. These filters were cylindrical vessels in which a wire cage supported a canvas filter bag, some pressure being obtained by inflating a rubber bag with water and placing it on the yeast before closing the filter.

The fermented wort is now beer or stout and passes to vats to mature. During recent years these vessels which were always of English oak have also been replaced in aluminium or stainless steel. The vats have also grown in capacity the original ones holding about 300 barrels each to the recent standard ones holding 2,500 barrels each. These latter are 27 ft in diameter by 24 ft 6 in deep. Further vat development is in hand and two of 40 ft diameter are under construction in stainless steel. Small ancillary tanks are required in a vathouse, and today these are of sectional cast iron or of stainless steel.

The cask is the traditional container for the finished product and originally casks were filled directly from the vats. In 1875 wooden racking tanks were in use away from the vathouses and in 1881 these were replaced by slate and iron tanks. The year 1860 saw the first racker (a container with a battery of hoses and cocks) installed; this method incorporating various developments is still in use. In recent years in Great Britain the wooden cask has given place to aluminium and stainless steel casks so that the cooper, whose craft is as old as the industry, will soon be but an honoured memory.

Although considerable quantities of Guinness still leave both breweries in casks ranging in size from 4½ gallons to 104 gallons, the bulk of the Park Royal output is delivered in tankers with capacities ranging from 1,440 to 3,000 gallons. For many years lead alloy beer mains were in use but these were replaced by tinned copper mains which were lapped longitudinally and brazed. Solid drawn tinned copper became the standard as this type of pipe became available and with stainless steel remains so today. The removal of lead alloy pipes in addition to achieving greater cleanliness also considerably reduced pilfering by secret tapping.

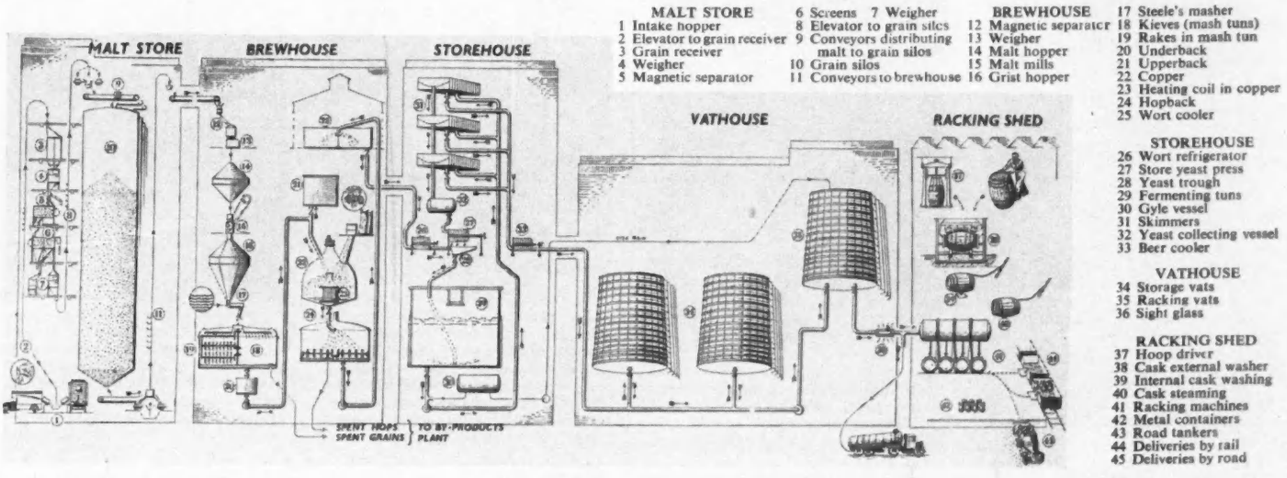
Hot water has always been required in large quantities in a brewery and prior to the introduction of the first steam engine in 1811, it is probable that water was heated by direct firing. After 1811 hot liquor was obtained by direct steam injection, this method later giving way to steam coils which in 1882 were replaced by heaters. The latent heat in the exhaust steam from the engines was first recovered in 1876 by the use of heaters in which the steam passed through tubes surrounded by water, circulation being by thermosyphonic action. In 1917 more efficient heaters were installed in which the steam passed over water tubes.

As Guinness has always been and remains one of the few naturally conditioned beers which is neither pasteurised nor carbonated, clean and sterile plant has always been essential. Over the years the means of achieving these conditions have developed from hosing out, through "scalding" with hot water, to flushing with cold water followed by steaming. The current sterilising procedure is applied to all mains, plant, vessels, containers and implements used subsequent to the brewhouse. It has been found more economical in fuel than hot water as well as more effective.

The brewing process involves cooling for the wort, beer and yeast. In the earliest days the wort was cooled by exposing it to the atmosphere in shallow tanks, the rate of cooling being increased later by the use of vanes revolving horizontally over the tanks. Between 1850 and 1870 various forms of enclosed coolers were in use with water as the cooling medium. In the hot season the temperature of the water was lowered before use by passing it over ice.

The beer in tun and vat was cooled by ice packed around the tops of these vessels. In 1870 mechanical refrigeration was installed (using ether as the refrigerant) and the use of ice discontinued except for the tuns. This development permitted the use of brine as well as chilled water as a cooling medium and made possible the efficient cooling of yeast. Carbon dioxide was first used as a refrigerant in 1890 and ammonia in 1910 when the use of ether ceased. It is a far cry from the first small condensing steam engine driven ether compressor to the latest ammonia machine driven by a 330 b.h.p. motor which is switched direct on to the 3,300 volt electric supply.

Electric light was first used in 1877 to enable new building work to proceed from 6 a.m. to 10 p.m., while in 1883 the first dynamo was installed to light some newly constructed offices. It was not until 1895 that the first turbogenerators were installed; these were two 60 kW units generating direct current at 220 volts. In 1899 direct current at 440 volts was adopted as standard and much of the plant in both breweries is still driven by 440 volt direct-current motors. The standard was changed to alternating current for all new plant, in 1948, mercury arc rectifiers being used to provide for the remainder of the economic life of existing direct-current electrical gear. The largest alternator being operated by Guinness at the present time is a 1,000 kW unit.



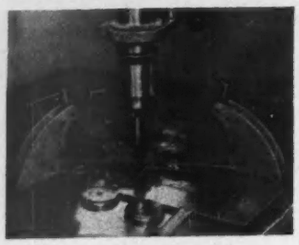
Guinness flow line.

As in other industries, the manufacturer needs to know as much as possible about the raw materials he uses. The Guinness company has for many years taken an active part in the development of hops and barley from both the agricultural and brewing points of view, to the benefit of the brewing industry as a whole as well as to themselves. Much still remains to be known about these materials (and also about yeast) even now, and large-scale laboratories are engaged in both breweries on research. Close control at all stages of the process is also given special attention. The first step from the traditional "magic" to the "scientific" was taken when in 1881 a microscope was bought in order to investigate the properties of yeast.

Many consumers will be unaware of—and perhaps would be disappointed to know—how much the scientist has contributed to producing and maintaining the standards of their glass of Guinness. At present, we learn from the posters, "5 million Guinness are enjoyed every day." Production on such a scale would be impossible without engineers.

WORK CLAMPS

Simple and Rigid



PARTICULAR claims for the Odoni rigid machine bed clamps are that they are cheap, adjustable, and can quickly be fixed to the bed of any light machine. There are no loose parts that can be lost.

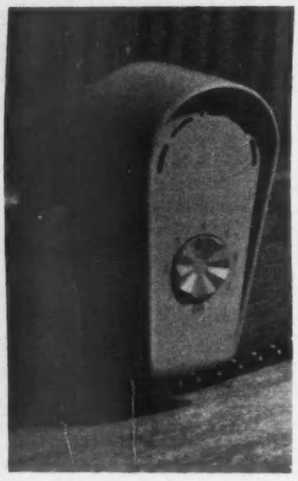
An adjustable bolt hangs from the body of the clamp and slides in the T slots of the machine bed. The load is taken by a roller at the rear that is wide enough to span a slot. From the front there projects the arm that is in contact with the workpiece, and which is free to swing in a vertical plane. Another roller at the end of the arm exerts the pressure on the workpiece itself. At the top of the clamp there is the clamping screw which bears on the work arm, and is used to effect gripping action. The bars allow full force to be applied by hand.

The adjusting screw has enough movement to allow for workpieces varying from 0·001 in to 2·25 in to be held securely on the bed. The leverage allows a force of up to ½ ton to be exerted at the point of contact. The clamps can be swung through an angle of 360° without adjustment. All the working parts that are subject to severe loading stress are made from high tensile alloy steel.

As the clamps require no shims, packing or straps, and can be fixed without a spanner, they can be fitted very quickly and easily. The holding power is said to be equivalent to that of a ⅜ in bolt. The base fitting is tapped ⅜ in Whitworth and adapts to any type of slotted bed. As standard they are supplied with slot bolts and washers. The clamps are sold boxed in pairs. *Odoni Equipment Limited, Salisbury House, London Wall, London, EC4.*

THERMOSTAT

For Plug-in Heaters



THE Pullin Plug-Stat is a thermostat for use with portable and semi-portable electric heaters.

The unit takes the place of the usual plug on the lead to the heater. It can have either 15 A round pins or standard 13 A flat pins for ring circuits. The pins of both types are mounted low at the back of the unit so that it will fit on plugs that are installed close to the floor. The lead to the heater is taken from the base of the unit.

The operating element is a large bi-metal strip arranged to have an adequate flow of air across it, so that the thermostat will react quickly to any change in room temperature. A neon indicator is fitted on the front which glows all the time that the heater is connected, irrespective of whether it is switched on or off. A protective sheet is fitted behind the louvres on the front so that it is impossible to reach the live terminals.

Control of temperature is to within 2° F over the range from 30° to 90°. The rating is from 80 to 250 V a.c. with a current of 15 A non-inductive. *R. B. Pullin and Company Limited, Phoenix Works, Great West Road, Brentford, Middlesex.*

MOBILE TOWER CRANES

Up to 5 tons Lift

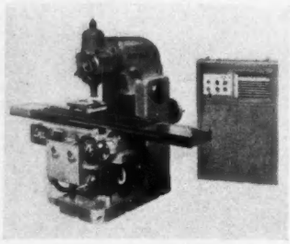
THREE new mobile tower cranes have been added to the Coles range.

The models are called the Industrious (illustrated), the Challenger, and the Vigorous, and they have lifting capacities of 2½ tons at 25 ft radius; 3 tons at 30 ft radius; and 5 tons at 30 ft radius, respectively. When fitted with the standard 30 ft strut jib they will each lift to a height of 43 ft.

A tower structure of steel tube raises the jib pivot 20 ft above ground level. The driver's cab is on the tower giving him an eye-level height 30 ft above ground. However, the road travel is only controlled from the lower cab. The cranes are able to raise and lower the tower without the aid of other plant; removing the structure allows the jib to be pivoted in front of the lower cab. Thus a normal strut crane is obtained, the conversion taking about an hour. Diesel-electric transmission is used to give hoisting, derricking, and full circle slewing. *Steels Engineering Products Limited, Crown Works, Sunderland.*

THREE DIMENSIONAL MILL

Programme Controlled



A RANGE of automatic three dimensional milling machines has been developed by Fritz Werner, with table sizes from 43 in by 12 in to 98 in by 24 in.

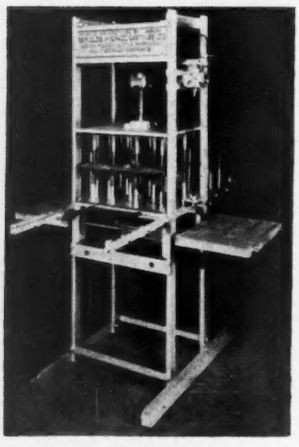
The machines are available in both vertical and horizontal types, and are standard models to which the control system has been added. They can therefore also be used with manual control. The model illustrated is the FV4 with a 71 in by 17 in table; at the right is the control cabinet with a 20 station panel. The panel includes the master control switches. Up to four banks of 20 push buttons, which determine the sequence of operations, can be incorporated in the cabinet.

Each bank consists of 20 columns of 15 buttons, the columns being numbered to denote the order in which the operations are carried out. The top row selects spindle rotation; rows 2 to 13 select feeds and traverses in both directions for table, saddle and knee; 14 is to interrupt the programme at any stage (for instance to change a cutter); and 15 marks the end of the cycle. Trip dogs on interchangeable carrier plates secured to the table, saddle and knee, control the lengths of traverses in each direction of motion.

The plates are easily removed and stored, together with masking templates for setting the push buttons, so that the machines can be used equally well for large or small batch work. Lights in each column indicate which stage is in operation. It is claimed that a considerable saving in machining time is effected as well as in setting up for batch work. *Rockwell Machine Tool Company Limited, Welsh Harp, Edgware Road, London, NW2.*

MOULD CLOSER

For Hot Shells



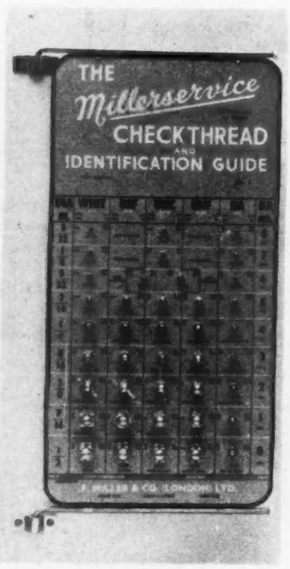
A CLOSING machine is now being made for bonding the halves of shell moulds.

It is designed for use with a thermosetting adhesive while the shells are still hot from the moulding machine. The shells are placed on one of the two loading stations where they are supported on spring loaded plungers, liquid or powdered thermosetting adhesive having been applied to the lower half mould. The moulds are accurately positioned against stops. The loaded station is moved into the closing press where a top plate equipped with a corresponding set of plungers is raised and lowered by a pneumatic cylinder. The press is closed and the adhesive sets.

The machine is fitted with two side tables where the hot shells from the moulding machine can be placed, face down, until they have passed the thermoplastic stage and can be supported on the plungers without fear of distortion. The machine will accommodate half moulds up to 6 in deep and any reasonable number of plungers may be used. With an adhesive setting time of 30 sec the capacity is about 100 moulds per hour. *Electric Resistance Furnace Company Limited, Netherby, Queens Road, Weybridge, Surrey.*

THREAD GUIDE

All Standard Sizes



THE wall chart illustrated gives a check for standard threads in the Whitworth, BSF, UNC, UNF, and BA ranges.

The board measures 24 in by 12 in and is supplied complete with fixing arms. The side shown allows any screwed component, male or female, to be checked and also types of nut to be identified. All the samples are clearly marked and so are the main thread dimensions. Tapping drill sizes are included for each.

On the reverse side are shown 25 types of screw and bolt heads in common use, 15 types of patent locking and special nuts, and 18 types of ordinary washers. In addition, the full range of shakeproof and spring locking washers has been included. The more popular range of plating has also been portrayed. This side of the board contains references to British standards wherever these apply, with respect to both components and to plating. *F. Miller and Company (London) Limited, Cambridge Avenue, Trading Estate, Slough, Buckinghamshire.*

HYDRAULIC PUMP

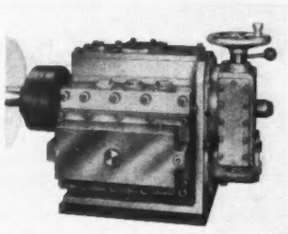
Variable Flow

A NEW hydraulic pump has been produced which has a variable rate of flow.

The pump is of the multi-piston type with the pistons driven from camshafts that run in roller bearings. The delivery and the suction valves are mitre seated for long wear. The basis of the whole design is a simple unit construction cobined with strong component parts intended to give hard continuous service over long periods accompanied by minimum maintenance and servicing.

The design is such that pairs of pistons are arranged to operate with common suction and delivery valves. It is possible to alter, by means of the hand control wheel, the relative position of the camshaft driving one piston with regard to the camshaft driving the other piston, so that an infinitely variable flow can be obtained ranging from zero to full capacity.

Full delivery pressure can be maintained right down to zero flow, and the pump can be run in either direction to



suit the direction of rotation of the prime mover, whether electric motor, diesel or petrol engine.

The range of pumps at present being made gives a choice of capacity from 7½ gallons per minute to 50 gallons per minute. The method of control for the flow rate can be chosen to suit any special requirement and may be manual, or mechanical or electronic to give automatic regulation according to operating conditions. The pumps can be supplied as separate units or, alternatively, constructed complete with prime mover for sale as power packs. *Sutcliffe Hydraulics Limited, Speedwell Works, Whitwood, Castleford, Yorkshire.*

WIRE GUN

Spraying Metal

THE Schori model 58 wire gun will spray all metals produced in wire form and is suitable for all building-up and surfacing work.

The gun is light and has few moving parts. It is fitted with a hand grip which when depressed operates the gas and air valves and starts the air motor which feeds the wire through the pistol. On releasing the grip the wire is stopped and the main gas and air supplies cut off, leaving a small pilot flame so that the operator has only to depress the grip again to restart the operation. This allows considerable economy.

The fuel gas, oxygen and compressed air can be conveyed to the pistol direct from the main supplies, or they can be fed through a panel mounted on a trolley which also accommodates the flow meter, wire reel stand, and air motor with its variable speed drive. As the air motor and the variable speed drive are mounted remote from the pistol, their weight is unimportant, and heavy duty units can be used, which are capable

of keeping the wire speed constant at the chosen rate and will give good reliability. As a result of this arrangement the gun is kept light and manoeuvrable so that even deposition is possible. *F. W. Berk and Company Limited (Schori Division), Brent Crescent, North Circular Road, London, NW10.*

LIFTING CLAMPS

For Vertical Plates

THE full range of Interlas lifting clamps is now available in this country.

Illustrated is one of the range of clamps for lifting plates in the vertical position. They are mechanically operated using a double cam mechanism. The greater the lift the tighter the cam operated jaws grip the plates. Even when the plates are resting on the ground the clamps cannot be removed until the locking lever at the side has been released. When freed, however, they can be withdrawn easily as there are rollers which run on the plates.

The vertical lifting clamps are available in seven sizes to accommodate loads from 1½ to 20 tons. The variation in plate thickness that the range covers is from ¾ in maximum to 3 in maximum. It is stated that the clamps can be affixed to the plate while the latter is in the horizontal position, and will then raise it to the vertical in safety. The reverse operation can also be carried out. In narrow gangways and for assembly, it is often more convenient for the

plates to be held vertically. *Interlas Limited, 9 Church Street, Ampthill, Bedford.*

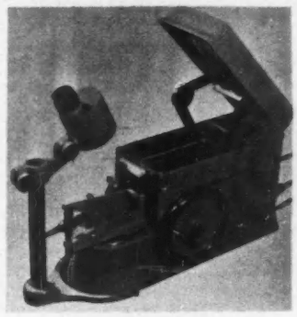
MICROTOME

Electron Microscope Specimens

AN Ultramicrotome has been developed by the Australian Commonwealth Scientific and Industrial Organisation that will consistantly cut sections less than 140 Angstrom units thick.

The most important feature claimed for the SI-RO-FLEX is that lateral movements of the specimen towards the knife have been minimised by means of a wide steel flexure strip thus making section quality less dependent upon the perfection of the knife. In addition, there are no bearings or slides to affect the uniformity of section thickness, also the quality of the sections cut is not so dependent on the operator.

The specimen is advanced to the knife by the thermal expansion of an arm of the instrument, through heat radiation from two tubular filament lamps. A continuously variable control of the heating source is provided. The knife holder can be moved towards the specimen by both coarse and fine controls and is magnetically clamped in the required position. The lamps are fitted



in the lid above the arm.

A microscope is used to view the blade and specimen, and in the illustration is set up for this. The instrument has variable cutting speeds and can be either hand or motor driven. It is also possible to transfer the hand wheel to the other side for left-handed operators. The specimen is illuminated by a fluorescent lamp. *Fairey Aviation Company of Australasia Pty. Limited, Salisbury, South Australia.*

REGISTRATION CONTROLLER

Small Size

SMALL size and the absence of a cam switch are two of the advantages claimed for a new registration controller for printing and packaging.

The equipment consists of two units, a scanning head type SC3, as illustrated, and a control unit that is made in two versions—PRC6 for one-way registration, and PRC7 for two-way control. Both incorporate a photoelectric gating circuit for controlling the operation of the appropriate correcting relay circuit.

One way registration requires a registration mark or part of the pattern to be scanned photoelectrically, and a correction mechanism to be fitted to the machine capable of retarding the position of the knife with respect to the strip feed.

For two-way registration control the knife mechanism or wrapper feed must be capable of correction in both directions while the strip is running. Both units have provision for connection to two pairs of viewing heads and light sources quite apart from the scanner.

These are used to monitor a gating disc.

The scanner measures 4½ in. by 2¾ in by 1¾ in and contains a light source, viewing head and optical system. It produces a small intense light spot focused at about 1 in from the lens. *Elcontrol Limited, Wilbury Way, Hitchin, Hertfordshire.*

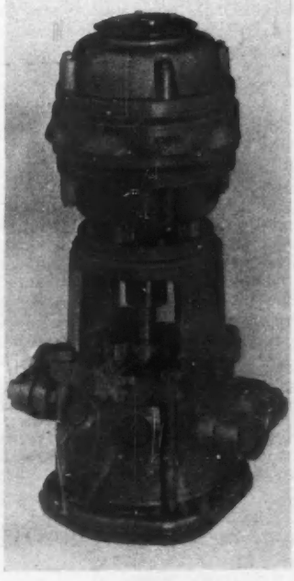
VERTICAL PUMP

Self-priming

AN addition to the PEP-Loewe range of centrifugal pumps is the VRL225, a small general purpose vertical model which is self-priming.

The pump will handle clear or cloudy liquids up to 220° F and oils up to 450 seconds Redwood No. 1 viscosity. Being self-priming it will also handle volatile products. The dynamic suction lift reaches 28 ft when pumping cold liquids and the capacities and heads available are 70 gallons per hour at 100 ft and 400 gallons per hour at 25 ft. The base area is less than 1 sq. ft.

The casing is designed so that if the foot valve on the suction line is inoperative, the pump will continue to work. The impeller has short blades to prevent breakage on bending. Pump and motor shafts are joined by a split coupling to maintain alignment. The motor normally fitted is rated at ½ h.p., three phase, but other types are available. *Precision Electrical Products (Stockport) Limited, Progress Works, Lytham Street, Cale Green, Stockport.*



Great Events of 100 Years Ago and More

One of the engineering centenaries of 1957, recorded in ENGINEERING for January 4 in that year, was the commencement in 1457 of what must have been at that time a major piece of civil engineering, namely, the artificial waterway constructed by Francesco Sforza, Duke of Milan, to connect that city with the River Adda, 15 miles away. The same undertaking forms a suitable starting point for this survey, for it was completed in 1460. It is strange, however, that the age which could plan and carry out such a practical and beneficial work could be so blind in other things; for when, 100 years later, Giambattista della Porta (1543-1615) founded in Naples the Academia Secretorum Naturae, the first society established for the study of physical science, he fell under suspicion of practising "illicit arts" and was obliged to disband it.

Londoners have good reason to remember 1560, for it appears to be now agreed—though 16th century dates of birth are not always precise—that in that year was born Sir Hugh Myddelton (died 1631), the Welsh goldsmith and clothmaker who gave London its first supply of reasonably pure water. Begun in 1609, his New River was inaugurated on 29 September, 1613; to quote from the inscription on the monument to Myddelton at Amwell, "An immortal work, since men cannot more nearly imitate the Diety than in bestowing health."

Another hundred years brings in an anniversary of some interest to engineers in general, for in 1660 died William Oughtred (born 1575), who devised various arithmetical signs and trigonometrical abbreviations, and has been credited with the invention of the slide-rule.

FORMATION OF ROYAL SOCIETY

Science, however, has the greatest cause to look back and up to 1660, for it was on 28 November, 1660, that twelve of the leading British savants of the day, after hearing a lecture by Christopher Wren (then only 28, and with 12 years still to wait for his knighthood) resolved to form themselves into a society "so they might do something answerable here for the promoting of experimentall philosophy," as was being being done "in other countryes." Thus began the Royal Society, though its Royal Charter of Incorporation was not sealed until 15 July, 1662. Wren drew up a preamble to the draft Charter, though in the event it was not embodied therein. It referred, *inter alia*, to chemistry as one of their studies; an interesting conjunction, for on 21 October, 1660, was born Georg Ernst Stahl (died 1734), protagonist of the phlogistic theory of combustion associated with the name of Johann Joachim Becher (1635-82) and which was exploded by Lavoisier in 1777.

The next centenary year, 1760, made an excellent start from the engineering point of view, for it was on New Year's Day, 1760, that the first furnace was tapped at Carron Iron Works, Falkirk; the most famous of Dr. John Roebuck's ventures and still in operation. It was there, nine years later, that the cylinder and piston were cast for James Watt's first engine, which Roebuck was confident would solve the problem of dewatering his coal mines. It might have done if Watt could have anticipated some of the success he was to achieve eventually; but that took many more years and, meanwhile, Roebuck's need was urgent. In the end it overcame him and he went bankrupt, to Watt's as well as his own distress: thus it came about that Matthew Boulton acquired the Kinneil engine and began his long association with Watt.

The original Carron furnaces were blown by water power, but eventually John Smeaton (1724-92) was called in to provide them with the first steam blowing-engines in ironmaking history; which recalls, through Smeaton, another anniversary, not often noticed. It was mentioned in his "Observations on the Graduation of Astronomical Instruments," presented to the Royal Society on 17 November, 1785; therein he noted that it was "in the year 1760" that "the very ingenious Mr. Ramsden"—the great Jesse Ramsden (1735-1800), perhaps the most renowned of all instrument makers—first "turned his thoughts towards making an engine for dividing mathematical instruments."

In 1760 died Jonathan Sisson, another London instrument maker, who had done good work for Greenwich Observatory. He is remembered here, however, for one of his failures; for it was to him that, in the first place, Glasgow University entrusted for repair their model of the Newcomen engine. They had some difficulty in recovering it from him in order to place it in the hands of Watt. Had Sisson succeeded in repairing it, the whole history of steam engineering must have taken a different course.

BLACK-FRIARS' BRIDGE

Some major works of civil engineering distinguish the year 1760. On May 7, as was recorded in *The Gentleman's Magazine* (though others say on June 7), "the first pile towards building the new bridge, at *Black-Friars*, was drove in the middle of the Thames." It was designed by Robert Mylne (1734-1811)—who, as engineer to the New River Company from 1770 till his death, put up the monument to Myddelton, previously mentioned—and was built with elliptical arches, which aroused much controversy. It stood for just 100 years, being taken down in 1860, the year in which the present Westminster Bridge was completed and Labelye's removed. In 1760, too, Bristol demolished its ancient bridge, dating from 1247, and began the construction of a new one in its place.

Two other events of 1760 deserve mention. In that year was founded the Norwegian Royal Society of Sciences, and Dr. Thomas Beddoes was born. Beddoes, an M.D. of Pembroke College, Oxford, established in 1798 at Clifton a "Pneumatic Institution" for the treatment of respiratory diseases by inhalation of oxygen and other gases, arguing that, as many such diseases were caused by breathing noxious vapours, they might be cured similarly by beneficial ones. Humphry Davy, as a young man, was employed by Beddoes as his demonstrator, and James Watt, whose family life was overshadowed by the deaths from consumption of his daughter Jessy and his son Gregory, took a great interest in Beddoes' work and made much of his pneumatic apparatus for him at Soho.

NAVAL ARCHITECTS

In recording the many centenaries of technical interest which link 1960 with 1860, pride of place must be given to the foundation of the Institution of Naval Architects, now, by the gracious decree of Her Majesty the Queen, become "Royal." The meeting at which it was established was held on 16 January in the hall of the Royal Society of Arts. The founders numbered 18, prominent among them being John Scott Russell, John Penn (then President of the Institution of Mechanical Engineers) and E. J. (later Sir Edward) Reed, who acted at Hon. Secretary. The chair was taken by Henry Chatfield, a former Master Shipwright of Devonport Dockyard. Oliver Lang, Master Shipwright at Chatham, moved, and John White, of Cowes, seconded the resolution "That we who are here present do now constitute ourselves an Institution of Naval Architects, for the purpose of advancing the science and the art of Naval Architecture"; an aim which has been steadfastly pursued and abundantly realised.

Three weeks later, on 6 February, was born one of the best known of the Clydeside shipbuilders of his day, Sir Archibald Denny, Bt. (died 1936). As head for many years of the Denny shipyard and engine works at Dumbarton, he was intimately concerned with many important advances, especially in marine steam engineering. He was one of the founders, in 1890, of the British Corporation Register, now merged with Lloyd's Register of Shipping.

Other engineers of note who were born in 1860 include Professor George Frederick Charnock (died 1929) of Bradford Technical College, a strong advocate of close collaboration between such colleges and the engineering industry—from the time that he went there in 1883 until his death, some 40,000 commercial tests were carried out under his direction; William Henry Watkinson, Wh.Sc. (died 1932), once a half-timer in a Keighley woollen mill, who became personal assistant to Kelvin and later Harrison Professor of Engineering in the University of Liverpool, where he did much original work on combustion and heat transmission and installed one of the earliest diesel engines, which for a time (following Rudolf Diesel's original intention) he ran on coal dust; and Frederick Bland (died 1934), specialist on tramway track, which was his professional concern for more than 50 years. By coincidence he was born in the year in which George Francis Train constructed in Birkenhead the first street tramway in the British Isles; it was 1¼ miles long, and was opened on 30 August, 1860.

On 12 May, 1860, died Sir Charles Barry (born 1795), architect of the present Houses of Parliament and father of the eminent civil engineer Sir John Wolfe Barry; he died just a week before the completion of the Victoria Tower. A few weeks earlier, on 23 February, died in Charlestown, South Carolina, Joseph Miller (born 1797), late of the famous Thamesside engineering firm of Miller and Ravenhill. He left all his scientific papers and drawings to the Institution of Civil Engineers, together with a bequest of £5,000, which was used to found and endow the Miller Prizes and Scholarships. In 1860, too, died that most pertinacious American inventor, Charles Goodyear, discoverer in 1839 of the process of vulcanising rubber.

In the electrical field, 1860 is notable for the invention by Dr. Antonio Pacinotti of his first electromagnetic machine, constructed for the Museum of Technological Physics in the University of Pisa, and for Gaston Planté's invention of his lead storage battery.

In 1860 John Elder, whose firm, originally Randolph, Elder and Company, is now the Fairfield Shipbuilding and Engineering Company, built his first ship, the Macgregor Laird, and John Laird, who was Macgregor Laird's brother, set a new pace in channel steamer design with the Ulster, Munster and Connaught for the Holyhead-Kingstown service. A fourth ship, the Leinster, was built on the Thames by J. d'A. Samuda.

Birkenhead's large dock basin, the Great Float, was completed in 1860, after some delay due to the bursting of a culvert which caused extensive damage; work was begun on the breakwater at Table Bay, South Africa, and on the Falmouth docks; and a start was made in France with the canalisation of the upper Seine.

Victoria Station, London, was opened in 1860—with broad-gauge and standard-gauge tracks, for the Great Western Railway shared it; and erection was begun of the Charing Cross railway bridge, for which the contractor, John Cochrane, designed a multiple drilling machine.

In its ultimate effects, however—or, at least, in the vast developments to which it pointed the way—possibly the great event of 1860 was the grant to J. J. E. Lenoir (1822-1900) of patents, in France and in England, for what proved to be the first practical gas engine and the first prime mover to compete with steam for small powers. In that year he built only two, but within five years nearly 500 were at work.

Instrumental Suite

It is not enough to build a working reactor or production plant, or do an experiment: these facilities must also be controlled, operated, and monitored. What is commonly known as the "bits and pieces" of a project—the instrumentation, the safety equipment, the control and recording apparatus—may be only a small percentage of the capital outlay, but is nevertheless the basis for a growing industry and a growing export market. The search for nuclear instrumentation has often lead to discoveries that can be applied in other fields of engineering; and, conversely, much has been borrowed for use in nuclear instrumentation. The process of cross-fertilisation becomes apparent from the developments recorded below.

Sequential Sampling to Monitor Weak Radiation

A five-fold reduction in average counting time without loss of accuracy can result from the use of sequential sampling when applied to hand or clothing monitors for weak radiation. The method, a principle familiar in production control, can be used when rejection criterion is a "set level": in the case of radiation monitoring a certain count rate. As the absolute value of the count is immaterial, a small statistical sample—or short counting time—is acceptable whenever the count falls short or exceeds the set level by a wide margin. Statistical accuracy is only needed near the set level. In sequential sampling, the difference between the actual and the rejection level count rate is integrated until a predetermined level, positive or negative, is reached. The monitoring time thus depends on how close the count approximates the set level and those differing widely are quickly processed. When the actual count and the set level are equal, the counting time would be infinite. To eliminate unduly long counts, the machine can be made to shut itself off after a certain time and—depending on the application—either reject or give a special indication to permit a more accurate check of the count. The electronics division of the UKAEA have studied several forms of sequential sampling instruments. In an analogue form, the count is represented as a charge which accumulates on a condenser. At the same time charge is also drained from the condenser to represent the "set level." The test is ended when the accumulated charge reaches a predetermined positive or negative value. In an alternative digital form, a standard pulse source feeds steady negative signals to a reversible counting device. Subtraction of the two signals is performed by the counters.

Hand and Clothing Monitor

Time-clocks and hand monitors usually stand side by side at nuclear establishments. The Emirad hand and clothing monitors take five seconds to perform a hand count and at the same time clothing and footwear are also checked. Visible and audible warnings operate when the maximum permissible dose is exceeded. Automatic compensation for background radiation permits siting of the monitor at any convenient location regardless of the ambient radiation level.

Noble Gas Impurities Determined

Variation of the discharge current passing through a noble gas under a steady alternating current potential may be used to measure the concentration of impurities up to 20 per cent in noble gases. Previous methods comparing the colour of the discharge were suitable only for very low impurity concentrations (up to 1,500 p.p.m.). A current meter is used in conjunction with a constant potential discharge tube. The instrument is calibrated by introducing known quantities of impurities such as nitrogen, oxygen or water vapour, into argon at constant pressure, and measuring the current. The instrument's sensitivity varies with gas pressure, and higher concentrations of contaminants may be measured if the discharge tube pressure is reduced. The instrument was developed by the UKAEA and will be produced under licence by Western Detail Manufacturers.

Liquid Levels to One Part in Hundred Thousand

Changes in the level of various liquids are indicated with extreme accuracy by a new instrument called the "hunting probe." A motor operated probe projects from the top of the container. The motor lowers the probe until it touches the surface of the liquid. An electrical circuit is completed in the platinum tip of the probe by the liquid and an electrical pulse fires a thyratron. The thyratron energises an auxiliary field in the motor windings which reverses the rotation and the probe is raised until contact with the liquid is broken. In operation, the instrument is constantly "hunting" with an amplitude of a few thousandths of an inch, and the average position is used as the best approximation for the liquid level. The probe will operate with high-dialectric-strength liquids up to 20 megohms resistance between contact and earth. Patent rights to the instrument are held by the UKAEA, who developed it for use with water-moderated reactors where the water level in the core determines the power output. Such an application would be the Vickers steam-cooled heavy-water moderated reactor (ENGNG., vol. 187, 1959, p. 792).

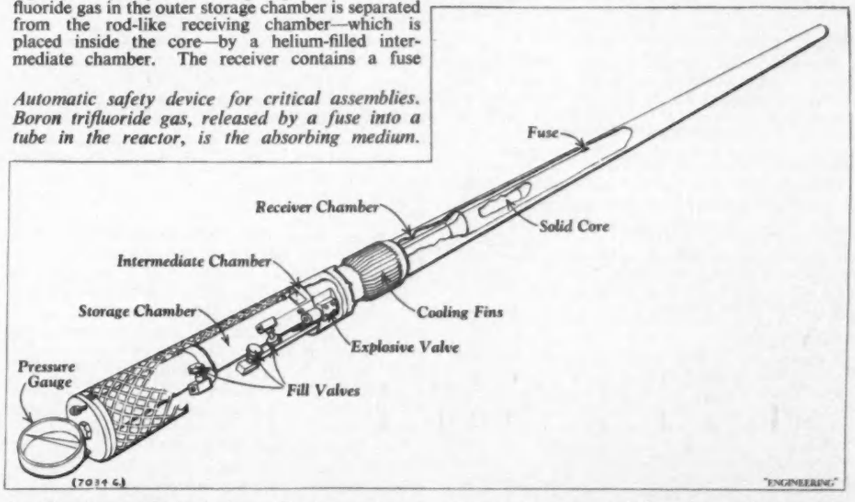
Inspection of Welds with Radioisotopes

Large radioisotope sources for the inspection of welds are inconvenient to use owing to the need to evacuate personnel from the area where an exposure is being made. A source container is undergoing field trials which permits radiographic exposure of welds up to 2 in thick but will not endanger personnel as near as 3 ft to the source. To make an exposure, a lead container with a 2 curie iridium 192 source is placed on one side of the weld, with the photographic film on the other. The container is designed to maintain the correct relative distance between film and source for a limited range of plate thicknesses when placed flush against the weld. Iridium was found to give best results for plate thicknesses varying from $\frac{1}{2}$ to $1\frac{3}{4}$ in.

Automatic Safety Device for Critical Assemblies

To guard against power excursions in critical assemblies, an automatic safety device has been perfected by Atomics International. The device, illustrated below, consists of three chambers separated by rupturable diaphragms. Boron trifluoride gas in the outer storage chamber is separated from the rod-like receiving chamber—which is placed inside the core—by a helium-filled intermediate chamber. The receiver contains a fuse loaded with enriched uranium. During a power excursion, the uranium heats and melts the fuse which, releasing the helium from the intermediate chamber, ruptures the diaphragm of the storage chamber and the gaseous poison is allowed into the receiver. The same sequence of events may be precipitated manually by setting off a small explosive charge, in which case the device acts as a fast control rod. The total time response is about 20 milliseconds. (A Safety Device for Critical Assemblies, by S. H. Fitch, 1959 ANS Winter Meeting paper 22-3.)

Automatic safety device for critical assemblies. Boron trifluoride gas, released by a fuse into a tube in the reactor, is the absorbing medium.



Fluidised Bed Control

Conditions prevailing in a fluidised-bed reactor—whether chemical or nuclear—can be determined with a new probe which measures the change in the heat transfer coefficient of the fluidised gas—particle mixture. A probe projecting into the fluidised material is heated electrically to a temperature above that of the fluid. The electrical power input required to maintain a steady temperature is a measure of the heat transfer from probe to fluid. The instrument is sensitive to changes in pressure, density, fluid composition or flow rate in the vicinity of the probe, all of which affect heat transfer. Advantages of the new instrument, developed by the UKAEA, are small size, resistance to shock, freedom from clogging and independence from the electrical conductivity of the fluid.

Cost of Control Rods

Control rod materials are hafnium, boron steel, titanium-boron dispersion, titanium-iron dispersions, europium oxide and stainless-steel dispersions, and mixtures of europium oxide and boron or gadolinium oxide. A comparison of control rod costs for a hypothetical 100 MW(t) water-cooled reactor using 19 control and shutdown rods shows that hafnium rods are competitive only when the material is derived as a byproduct of zirconium extraction. For long endurance applications cermets of europium oxide and stainless steel, and composite rods with boron or gadolinium oxide upper blades and hafnium or europium oxide tips are quite attractive. Rods using boron poison are applicable only as shutdown rods owing to severe swelling and cracking when exposed to large thermal neutron doses. (Comparative Costs of Control Rods for a Hypothetical 100 MW reactor as a Function of Materials Costs, W. K. Anderson, C. J. Beck and J. S. Theilacker, 1959 ANS Winter Meeting, paper 6-2.)

Computer Programme for Thermal Neutron Flux

A computer programme for the calculation of thermal neutron flux near an infinite-plane temperature discontinuity was developed, suitable for the IBM-709 digital computer. The programme, coded SYZYGY, is completely self contained and requires only the physical parameters of the media, the temperatures of the media and numbers giving the energy and position ranges desired. The time required for the solution of a typical programme is three minutes. (An IBM-709 Program for Calculating the Thermal Neutron Flux Spectrum Near a Temperature Discontinuity, J. E. Schlosser, 1959 ANS Winter Meeting, paper 8-3.)

Large Pulsed Neutron Source

A subcritical assembly using standard Triga fuel elements and a water moderator was used to determine parameters required for a large pulsed neutron source with variable leakage spectrum. The suitability of the Triga uranium-zirconium hydride fuel for obtaining short intense bursts of neutrons has been shown in transient studies. Calculations have been performed on characteristics of reflectors suitable for a pulsed reactor. Such reflectors must have high leakage but must effectively decouple the region outside the reflector from the core. (Water-Cooled U-Zr-H Subcritical Assembly Measurements for the Development of Pulsed Neutron Sources, R. S. Stone, G. B. West and H. P. Sleeper jr., 1959 ANS Winter Meeting, paper 9-2.)

Theory of Pile Noise Simplified

Pile noise is the statistical fluctuation of neutron population in a reactor. In a simplified theory the pile noise is considered as arising from a noise equivalent neutron source of random strength. The neutron source represents fluctuations in the number of neutrons available to the reactor caused by statistical variations in the rate of neutron absorption and production. The magnitude of the source is calculated from conventional noise theory, and the neutron population fluctuations are calculated by use of a source transfer function. (A Simple Theory

of Pile Noise, C. E. Cohn, 1959, ANS Winter Meeting, paper 5-5.)

Closed Circuit Television for CERN Synchrotron

The European Organisation for Nuclear Research (CERN) has decided to equip its 25 GeV proton synchrotron with industrial television. An order for the supply and installation of two cameras, three receivers and auxiliary apparatus has been placed by ACEC-Belgium, a company which already built all the exciting coils for the large accelerators of the first international nuclear research centre.

Television and Remote Handling

The activities of the remote handling division of Savage and Parsons Limited, Watford, are being extended to cover the supply of closed circuit industrial television equipment to nuclear research and experimental establishments throughout the world. This is the main effect of a recent agreement between Savage and Parsons and Marconi's Wireless Telegraph Company Limited, Chelmsford. The television equipment, which is claimed to be a logical adjunct to remote handling equipment, includes the Marconi Vidicon camera and a 14 in Marconi picture monitor.

Television Viewing Equipment at Merlin

Two television cameras are permanently installed in the Merlin reactor. One is mounted above the core on the second floor of the reactor hall and is used to observe the floor when the reactor is operating. The installation is designed to prevent accidents arising from unauthorised entry to dangerous areas.

A second camera, encased in aluminium, can be submerged in the moderator and is used to view the core during fuelling and also during reactor operation. Receivers are mounted in the control room, the second floor of the reactor building, and in the conference room. The equipment was supplied by EMI.

General Purpose Scintillation Counter

A sodium iodide scintillation counter with 12-stage photo multiplication is made by Research and Control Instruments for medical and biological use. The thallium activated scintillation crystal has large diameter, and high resolution is claimed.

Scintillation Counter for Hospitals

Stainless-steel enclosure permits cold sterilisation of a scintillation counter for hospital use. The Ekco N618 counter may be fitted with directional shield and any one of three standard collimators to provide alternative angles of acceptance. The counter also incorporates a continuously adjustable coincident light-spot range finder to facilitate accurate positioning relative to the patient.

Pulse Analysers

Identification of radiation emanating from various isotopes, and determination of the energy distribution requires the analysis of the peak-signal amplitudes produced in the radiation detector. The single-channel pulse-height analyser, a product of Plessey Nucleonics, measures the distribution of pulse heights by counting pulses falling within the channel width at any selected amplitude. Fifty pulse-height analysers have been delivered to Harwell.

Survey Trolley for Health Physics

Dose rate meters are installed on a portable trolley at the high-energy laboratory of CERN in Geneva. The radiation survey tool consists of two Vibron dose rate meters, one with a "tissue equivalent," the other with an argon filled ionisation chamber. Gamma ray and heavy particle dose rates can be calculated from the two indications. The survey trolley, which has a battery and a motor generator for use in remote areas, also carries small hand instruments for slow and fast neutron and gamma ray measurement. The Vibron instruments are made by EIL.

Sweden Orders Manipulators

A contract worth approximately £15,000 for 12 Master Slave manipulators for the remote handling of radioactive materials has been placed with Savage and Parsons Limited by Atkiebolaget Atomenergi, Sweden. Since these manipulators came off the restricted list two years ago, 98 have been exported to Sweden, Norway, Germany, Italy, Spain, India, South Africa, France and Belgium, and supplied to most research establishments of the United Kingdom Atomic Energy Authority. The total value of all the contracts is well over £120,000.

250 kV X-Ray Machine at Hinkley Point

Constant potential type X-ray equipment of 250 kV power is in use at Hinkley Point for the inspection of field welds on the reactor and heat exchanger vessels. A standard Marconi apparatus comprising transformer, rectifier, oil cooled tubehead, and oil circulators, is fitted with a taller than normal tube column to facilitate inspection of large vessels.

Reactivity Control

A recently published United States patent relates to a device for rapidly controlling the reactivity of an active portion of a reactor. The invention consists of coaxially disposed members each having circumferential sections of material having different neutron absorbing characteristics and means for moving the members rotatably and translatably relative to each other within the active portion to vary the neutron flux therein. The angular and translational movements of any member change the neutron flux shadowing effect of that member upon the other member. (J. R. Dietrich and J. M. Harrer, Patent No. 2,852,458.)

Teddington Tackle Safety and Control

The nuclear division of Teddington Aircraft Controls Limited, the formation of which was announced in Atomic Review 26 Dec. 1958, is to make a special study of reactor behaviour with a view to the development of comprehensive safety instrumentation and control equipment. Initially, work will be concerned with large gas-cooled reactors of current and proposed designs, but later advanced gas-cooled and fast reactors will be investigated.

Standard Neutron Detection Foils

Accurate, reproducible spectral determinations are possible using a newly developed system of neutron detection foils, made by Aerojet-General Nucleonics, PO Box 77, San Ramon, California. This system is said to make it possible to compare the results of various radiation-effect studies. Because such studies are only as complete as the neutron spectra data upon which they are based, these standard neutron detection foils provide an invaluable means of accurately correlating either single reactor system studies or similar studies using various reactors. Accurate cross-calibration and standardisation of fast neutron data are obtained by measuring the spectrum in six energy increments: (1) thermal fluxes are measured with gold or cobalt foils; (2) neutron energies greater than 1 keV are measured by plutonium-239 foils; (3) neutron energies greater than 1·5 MeV, by uranium-238 foils; (4) neutron energies greater than 2·9 MeV, by sulphur-32 foils; (5) neutron energies above 5·3 MeV are measured by analysing the products of the (n.p.) reaction in aluminium-27 foils; and (6) energies greater than 8·6 MeV, by analysing the products from the (n.α) reaction on aluminium-27 foils. A boron-10 shield is used to protect the fission foils from thermal neutrons during irradiation. Cadmium covers are available for use with the gold and cobalt foils for determining the cadmium ratio. Sulphur foils are repackaged in "cold" aluminium after their irradiation, thus eliminating the possibility of mistaking certain reactions in aluminium for those in sulphur. The scheme includes accessories and full service.

Hose for Remote Viewing Equipment

Power Auxiliaries Limited have assisted in designing remote equipment for examining the graphite moderator of reactors at Calder Hall. The company have designed and fabricated a Plessiflex seamless 80 ft stainless-steel hose for this equipment. The hose, of more than 2 in bore, carries seven smaller hoses internally, to provide hydraulic power and other services. All these hoses are braided in fully stabilised stainless-steel wire of welded construction. This strong hose is also used as the crane rope for carrying the weight of the equipment.

GEC Power Manipulator for Windscale

The atomic energy division of the General Electric Company Limited has received an order for a power-operated manipulator from the Industrial Group of the United Kingdom Atomic Energy Authority. This manipulator will form part of the expanding hot laboratory facilities at the Authority's Windscale establishment, where its primary use will be in the inspection of irradiated fuel elements. The manipulator was described in Atomic Review on 28 March, 1958.

Transfer Function Analyser at Halden

Part of the experimental equipment at the Halden boiling heavy-water reactor is a transfer function analyser of UKAEA design and construction. By modulating the reactivity with sinusoidal frequency in the range of 10 to 0·002 cycles per second, data on the physics and dynamic behaviour of the reactor may be collected. Phase and amplitude of the neutron flux response to the external disturbance will be measured with an accuracy of one degree and 1 per cent respectively. Installation of the apparatus has recently been completed under the supervision of personnel from the Winfrith establishment.

Notes and News

Parliamentary Review of Canadian Atomic Programme

From Toronto, *The Globe and Mail* reports that the Canadian Cabinet is planning to hold an inquiry into the programme of the crown company Atomic Energy of Canada Limited (AECL) as a result of the controversy between Mr. J. L. Gray, president of AECL, and Mr. Winnett Boyd over the wisdom of Canada's concentration on the heavy-water reactor. Details of the controversy appeared in Atomic Review on 23 October and 13 November, 1959. Although Mr. G. M. Churchill, Trade Minister responsible for the activities of AECL, said that no cabinet decision has been taken, the informants of *The Globe and Mail* are certain that the inquiry by a special parliamentary committee will be held during the coming session. Investigation of the atomic energy programme is not taken as indication of lack of faith in Government circles in the direction of AECL. The Government's aim, it is believed, is to obtain a satisfactory answer to the vocal criticism of Mr. Winnett Boyd and Dr. John Davis, director of research and planning of British Columbia Electric Company. The special committee's terms of reference will be to answer two questions: is the present line of development right; and are the funds for atomic energy development adequate?

Continued High Investment at CERN

The costliest piece of equipment at the nuclear research centre of CERN at Meyrin near Geneva is now operating and its performance exceeds expectations. Early in December the nominally 25 GeV proton synchrotron was operated at 30 GeV, 1·7 above the maximum expected performance. In spite of completion of the synchrotron, the second phase of capital investment covering construction of auxiliary equipment and experimental facilities, will be at a sustained level. The budget for 1960 provides SF65 million (£5·4 million), of which SF38·5 million will cover the capital investment, the balance the operating costs. In contrast, last year's budget was only SF55 million. Under the terms of European cooperation in nuclear research, the United Kingdom has undertaken to provide 25 per cent of the centre's budget compared with 21·22 per cent for France and 19·52 per cent for the Federal German Republic.

Zenith in Operation

As an important step in project Dragon for the development of a high-temperature gas-cooled reactor, Zenith, a critical assembly for high-temperature experiments at Winfrith reached criticality on 19 December. (Atomic Review, 3 Sept. '59.) When commissioning will be completed in about two months' time, the facility will be used to check the reactor physics calculations for the 20 MW HTGCR being built under project Dragon. Although the project is now under the aegis of OEEC, Zenith will be operated by UKAEA staff.

Japanese Government Approve Reactor Project

Formal approval of the construction of a gas-cooled reactor at Tokai Mura has been given by the Japanese Government. The reactor will be supplied by the General Electric Company and constructed by the Japanese subsidiary British General Electric of Japan.

'Engineering' Appointments Section

Central Electricity Generating Board

RESEARCH AND DEVELOPMENT DEPARTMENT
RESEARCH LABORATORIES, LEATHERHEAD, SURREY
MECHANICAL AND CIVIL ENGINEERING SECTION

(*a*) **EXPERIMENTAL STRESS ANALYSTS** are required to extend the present research effort devoted to the development of methods for measuring static and dynamic stresses both at high temperatures and over long periods of time. Techniques developed in the Laboratories will be applied to components on site in order to investigate working stresses.

(*b*) **THEORETICAL AND EXPERIMENTAL STRESS ANALYSTS** are required to investigate in the Laboratory the stressing of pressure vessels and other components associated with nuclear power reactors.

For the senior posts, candidates should have a good Honours degree in Engineering or Physics, together with experience in theoretical stress analysis as applied to engineering design or in the application of modern experimental stress analysis techniques to models and full scale components. For the remainder the minimum qualifications are a Higher National Certificate in Engineering or Physics with some industrial or research experience. Applications are also invited from Graduates direct from University who hold a good Honours degree.

Salaries according to duties and responsibilities on a scale within one of the following ranges, £1195 — £1775 p.a. or, up to £1300 p.a.

Applications stating age, qualifications, experience, present position and salary, to the Personnel Officer, 24/30, Holborn, London, E.C.1, by 15th January. Envelopes should be marked "Confidential Ref. ENG/475."

A 964

ATOMIC ENERGY ESTABLISHMENT, WINFRITH

PROFESSIONALLY QUALIFIED ENGINEERS

are required to work on a shift basis in the control of operation and maintenance. Experience in the following fields is essential:—

(*a*) Control of sub-stations and power supplies.

(*b*) Operation and maintenance of boiler and machinery plant, including pumping and heating, and ventilating equipment.

(*c*) Maintenance of Site Services, including effluent disposal.

Duties will also involve supporting the Health Physics Organisation, which will require an intensive training course in radiation hazards and their control. Managerial ability is required; and experience of damage control duties, or of work in radioactive areas would be an advantage.

Salary £1345-£1800 per annum.

Housing and superannuation schemes.

Send POSTCARD for application form and details to:—

PERSONNEL BRANCH (W.209/26),
U.K.A.E.A.,
A.E.E. WINFRITH, DORCHESTER, DORSET

not later than February 2nd, 1960. A 959

Hawker Siddeley Aviation LIMITED

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LIMITED
wish to appoint a

MECHANICAL ENGINEER

to undertake mechanical and hydraulic engineering development work on guided missile and auxiliary Power Supply units.

Candidates should have a university degree in Mechanical Engineering or equivalent qualification, and experience in the design and development of mechanical or hydraulic equipment. Some knowledge of Chemical Engineering would also be an advantage.

The work is of a varied and interesting nature, offering ample scope for original thought.

The commencing salary will be according to qualifications and experience and will be progressive on a merit basis.

Company benefits include a generous Pension and Life Assurance Scheme.

Interviews will be arranged at our Whitley Works, near Coventry, and applications should be addressed to:—

Technical Appointments Officer,
Sir W. G. Armstrong Whitworth Aircraft Limited,
Baginton, Near Coventry
quoting reference TAO/Mech. Dev./5. A 934

PUBLIC APPOINTMENTS

AIR MINISTRY

AIR MINISTRY require ASSISTANT MECHANICAL AND ELECTRICAL ENGINEERS for design, construction and maintenance of installations on airfields, radar stations, missile bases, workshops and maintenance units for R.A.F. at home and overseas as well as certain Civil Airports. Salary—£805 at 25 to £1095 at 34 or over, thereafter rising to max. £1260 with increase for London and slight decrease for country districts. Appointments non-pensionable but long term. Promotion prospects. 5-day week with 4 weeks 2 days leave a year initially. Special allowance in addition to salary during overseas service. QUALIFICATIONS AND EXPERIENCE (i) (*a*) Degree or equivalent diploma in electrical and/or mechanical engineering with at least 2 years apprenticeship or (*b*) Graduate or corporate member of I.E.E. with at least 3 years apprenticeship, or (*c*) Graduate or corporate member of I.Mech.E. appreciable electrical engineering experience with at least 3 years apprenticeship, and (ii) have been employed for minimum of two years with well established engineering concern and gained wide experience in both electrical and mechanical engineering practice. Applicants must be natural born British subjects aged 25 to 45. Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting D 555/9A.

G 836

VACANCIES FOR TWO ENGINEERING CLERKS

Applications are invited for these two vacancies on the staff of the CHIEF RESIDENT ENGINEER of several large pipelaying contracts in Lanarkshire.

The duties of the successful applicants would include the maintenance of filing systems, checking interim and final certificates of Contractors, copy typing and general office routine.

Previous experience of engineering works office routine would be advantageous.

It is anticipated that the appointments would be for about 18 months.

Salaries would be £600 per annum.

Written applications, with age and full particulars, should be addressed to the Chief Resident Engineer, Daer Water Scheme, c/o The Clerk to the DAER WATER BOARD, P.O. BOX No. 1, LANARKSHIRE HOUSE, 191, INGRAM STREET, GLASGOW, C.1, not later than 20th January, 1960. Interviews by appointment will be held in Glasgow during the first week in February. A 906

BRADFORD INSTITUTE OF TECHNOLOGY

PRINCIPAL: E. G. EDWARDS, Ph.D., B.Sc., F.R.I.C.

Applications are invited for the post of
READER IN MECHANICAL ENGINEERING

Candidates should possess the qualifications and experience to direct research and post-graduate work, and to take a leading part in advanced teaching. Importance will be attached to industrial and research experience. Adequate facilities will be given to undertake research and suitable technical assistance and equipment are available. Staff are encouraged to develop industrial contacts and to undertake consultant work in industry and may retain fees paid for such work.

Salary Scale: £1800 to £2100 per annum.

Previous industrial and research experience at a suitable level will be taken into account in fixing the commencing salary.

Further particulars and forms of application may be obtained from THE REGISTRAR, BRADFORD INSTITUTE OF TECHNOLOGY, BRADFORD 7.

W. H. LEATHEM,
CLERK TO THE GOVERNORS.
A 928

BRADFORD INSTITUTE OF TECHNOLOGY

Principal: E. G. EDWARDS, Ph.D., B.Sc., F.R.I.C.

Applications are invited for the position of:—
PRINCIPAL LECTURER IN MECHANICAL ENGINEERING

Candidates should be qualified to teach to final degree standard preferably in Thermodynamics and Mechanics of Fluids and should have had adequate industrial experience.

The successful candidate will be expected to assist the Head of the Department with the administrative work of the Department and will be encouraged to develop industrial contacts.

Salary scale: £1750 to £1900 per annum.

Previous industrial and research experience, at a suitable level, will be taken into account in fixing the commencing salary.

Further particulars and forms of application may be obtained from the REGISTRAR, BRADFORD INSTITUTE OF TECHNOLOGY, BRADFORD, 7.

W. H. LEATHEM,
CLERK TO THE GOVERNORS. A 957

MINISTRY OF POWER

MIN. OF POWER, H.Q., London, require TECHNICAL EDITOR (Experimental Officer) pref. under 31. Duties: abstracting scientific articles; preparation of surveys of current literature; briefs and memoranda on fuel and power subjects. Min. quals. H.N.C. or InterB.Sc. or equiv. Some knowledge of terms used in fields of fuel and power, and ability to translate French and German essential; knowledge of Russian an advantage. Salary: £1005-£1233 (men), £985-£1203 (women). Five-day week.—Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting A.572/9A. Closing date 29th January, 1960. A 961

BRADFORD INSTITUTE OF TECHNOLOGY

PRINCIPAL: E. G. EDWARDS, Ph.D., B.Sc., F.R.I.C.

Applications are invited for the posts of
SENIOR LECTURER IN MECHANICAL ENGINEERING
LECTURER IN MECHANICAL ENGINEERING

Candidates should be well-qualified and industrial and research experience would be a recommendation. The successful candidates will be required to teach one or more subjects to honours degree standard. They will be encouraged to undertake research and adequate facilities will be available.

Salary Scales: Senior Lecturer, £1550-£1750 per annum.
Lecturer, £1370-£1550 annum.

Previous industrial and research experience at a suitable level may be taken into account in fixing the commencing salary.

Further particulars and forms of application may be obtained from the Registrar, BRADFORD INSTITUTE OF TECHNOLOGY, BRADFORD, 7.

W. H. LEATHEM,
CLERK TO THE GOVERNORS.
A 927

GOVERNMENT OF THE FEDERATION OF RHODESIA AND NYASALAND
VACANCY: MECHANICAL ENGINEER
DEPARTMENT OF CONSERVATION AND EXTENSION: NORTHERN RHODESIA
MINISTRY OF AGRICULTURE

Applicants must hold a recognised degree in Mechanical Engineering and/or be a corporate member of the Institute of Mechanical Engineers, and should have experience in workshops and field organisation of plant and equipment. Experience in works costing and stores control will be an added recommendation.

Duties will include the organisation and control of the Department's fleet of heavy crawler tractors, ancillary equipment and vehicles, as well as the workshops and stores. He will also be required to give advice on mechanical matters.

Salary on the scale £1785-£1864 16s.-£1942 10s. Government housing while serving in Northern Rhodesia will be provided at a rental not exceeding 12½ per cent. of basic salary.

Application forms and further details from the SECRETARY (B), RHODESIA HOUSE, 429, STRAND, LONDON, W.C.2. Closing date 31st January, 1960. A 945

AIR MINISTRY

AIR MINISTRY requires EXPERIMENTAL/ASSISTANT EXPERIMENTAL OFFICERS in (1) Soils Laboratory, Cardington, Bedford, Ref. E 518/9A. (2) Ruislip, Middlesex, Ref. D 641/9A. (1) Duties: To take charge of small soil survey teams engaged on foundation investigations for runways, buildings and other civil engineering works at airfields, etc., and to progress and supervise associated laboratory testing. Work requires ability to use Geological Survey maps and publications in interpretation of results of survey. Qualifications: Higher School Certificate (pref. including geology) or H.N.C. or equiv. quals. and wide experience in responsible capacity in connection with field surveys and associated standard laboratory tests for soils investigations. (2) Duties: Experimental work in connection with installation, operation, adaptation and modification of radio equipment and aerials. Qualifications: H.N.C. Elec. or equiv. quals. and sound general knowledge of principles of radio; practical experience of one or more ground radio systems employed in R.A.F. such as navigational aids, air/ground communications, long range communications or radar an advantage. Salary scales: Cardington E.O. £954-£1166, A.E.O. £382 10s.-£830; Ruislip E.O. £1005-£1233; A.E.O. £397 10s.-£880. —Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting appropriate reference. A 936

ICI

draughtsmen

To meet an expanding programme of development,

IMPERIAL CHEMICAL INDUSTRIES LIMITED

PLASTICS DIVISION

urgently need more Draughtsmen. In particular, men are required experienced in work associated with process plant, e.g., piping, heating and ventilating, drying, powder conveying and packing. Mechanical draughtsmen are also needed since the programme includes development work in novel processes which are essentially mechanical in nature. There are vacancies too for men with instrument and electrical design experience.

Good starting salaries will be paid and pension and profit sharing schemes are in operation. For married men temporary lodging allowances are available and assistance is given towards house purchase and removal expenses.

Apply briefly to the Staff Manager,

IMPERIAL CHEMICAL INDUSTRIES LIMITED
PLASTICS DIVISION
BLACK FAN ROAD, WELWYN GARDEN CITY, HERTS.

A 939

DEVELOPMENT ENGINEER

A Qualified Mechanical Engineer, aged 25-35, is required to take charge of the Development Section of the Engineering Department in London of a major international food manufacturing Company, and to be responsible for carrying out the Company's engineering research programme.

A thorough engineering background is essential with academic training up to Degree or H.N.C. level. Practical experience in design, operation or development in some of the following processes is required:—food canning, wrapping and packaging—general food machinery—pharmaceutical and fine chemicals—and acid plant.

Initiative, ingenuity in design, and the ability to pursue a specified project from conception to final proofing are a fundamental requirement. This is a permanent appointment offering good prospects to a man with the ability and will to progress. Conditions of employment are excellent, and include a superannuation scheme. The salary will be assessed according to age, qualifications, and a record of proved ability.

Please write with full details of age, qualifications and experience to:—

BOX A 940, Offices of ENGINEERING

MATERIALS HANDLING ENGINEER

Required for a medium-sized company manufacturing specialised equipment for the vehicle and motor car industries. The Materials Handling Engineer will be responsible to the Production Engineer for materials handling and factory layout.

Essential Qualifications:—

(a) Experience in the preparation of materials handling schemes including palletisation and conveyorisation in current use in the light mass-production engineering industry.

(b) Sound knowledge of modern factory layout for batch and flow production in machine, assembly and plating shops.

(c) Knowledge of machine design, planning, work study and foundry practice would be an advantage.

Candidates should have professional qualifications in production or mechanical engineering.

Age group—30 to 45. Four-figure salary and non-contributory pension scheme.

Please send full details of career in confidence, quoting reference LRM/PE.2, to

CLAYTON DEWANDRE COMPANY LIMITED, TITANIC WORKS, LINCOLN.

A 867

UNIVERSITY OF CANTERBURY
NEW ZEALAND
LECTURER IN
MECHANICAL ENGINEERING

Applications are invited for the above-mentioned post. Applicants should have a degree in Mechanical Engineering of a recognised University, teaching experience at a University, or have held a responsible position in a branch of Mechanical Engineering.

The salary will be at the rate of £1025 per annum rising by annual increments of £50 to £1275 per annum. Commencing salary will be in accordance with qualifications and experience. An allowance is made towards travelling and removal expenses.

Further particulars and information as to the method of application may be obtained from the SECRETARY, ASSOCIATION OF UNIVERSITIES OF THE BRITISH COMMONWEALTH, 36, GORDON SQUARE, LONDON, W.C.1.

Applications close, in New Zealand and London, on 31st January, 1960. A 947

WAR OFFICE

WAR OFFICE require ENGINEER at Christchurch, Hampshire, for duties concerned with development and testing of construction plant (tractors, scrapers, graders and cranes). Qualifications: A.M.I.Mech.E. or equiv. Design experience in some branch of mechanical engineering and experience in use and operation of road-making machinery in general and in particular machines used in making and handling of bituminous materials, quarrying and concreting plant. Salary range, £780-£1680 according to age and experience. Appointment not established but opportunities to compete for establishment may arise.—Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting C.847/9A. A 948

UNIVERSITY OF SYDNEY
LECTURESHIP/SENIOR LECTURESHIP
IN ELECTRICAL ENGINEERING

Applications are invited for the above-mentioned position. Applicants should have good academic qualifications in Electrical Engineering, experience in the power field, and a working knowledge of electronic techniques. The successful applicant will take part in teaching, primarily in the field of electrical machines, and in research.

The salary for a Senior Lecturer is within the range £A2200-80-£2600 per annum; for a Lecturer within the range £A1500-90-£2100 per annum. In each case cost of living adjustment will be allowed. The salary is subject to deductions under the State Superannuation Act. The commencing salary will be fixed according to the qualifications and experience of the successful applicant.

Under the Staff Members' Housing Scheme in cases approved by the University and its Bankers, married men may be assisted by loans to purchase a house.

Further particulars and information as to the method of application may be obtained from the SECRETARY, ASSOCIATION OF UNIVERSITIES OF THE BRITISH COMMONWEALTH, 36, GORDON SQUARE, LONDON, W.C.1.

Applications close, in Australia and London, on 19th February, 1960. A 956

CIVIL ENGINEERS FOR
DEPARTMENT OF MAIN ROADS,
NEW SOUTH WALES, AUSTRALIA

Applications are invited from GRADUATES (or undergraduates in their final year) in Civil Engineering of a recognised British or Irish University for appointment to the staff of the Department of Main Roads, New South Wales, the State Road Authority for construction of roads and bridges.

On appointment, applicants may be engaged at the Department's Head Office, Sydney, on the design of reinforced concrete and steel bridges, or on main road construction and maintenance either in the Metropolitan Area or the country.

Commencing salary according to qualifications and experience will be within the range £A1185 to £1410 per annum, with annual progression, subject to technical competence to £A2095 per annum. Appointees will be eligible to contribute to the State Superannuation Fund after six months.

Appointee's full fare from England to Australia will be met by the Department, subject to a three years' service guarantee bond being completed. Appointment will be subject to passing a medical examination and preference will be given to applicants not more than 30 years of age.

Applications should be made on forms obtainable from the AGENT GENERAL for NEW SOUTH WALES, 56, STRAND, LONDON, W.C.2. When replying please quote this paper. A 954

THE UNITED LIVERPOOL HOSPITALS
TECHNICAL ASSISTANT

Applications are invited for the post of TECHNICAL ASSISTANT to assist the Superintendent Engineer. His duties will include the preparation of drawings and specifications. Applicants should be competent draughtsmen and experienced in heating and ventilating and general engineering work. The possession of an appropriate qualification would be an advantage. Salary £415 per annum at age 21 years rising by annual increments to £625 per annum (Works Assistant Grade). Whitley Council Terms and Conditions of Service.

Apply by 11th January, 1960, stating age, qualifications, experience and names and addresses of three persons to whom reference may be made to the SECRETARY, THE UNITED LIVERPOOL HOSPITALS, 80, RODNEY STREET, LIVERPOOL, 1. A 938

AIR MINISTRY

AIR MINISTRY Works Designs Branch requires in LONDON CIVIL ENGINEERING DESIGNER DRAUGHTSMEN with adequate training and drawing office experience in one or more of the following:—(a) Roads, pavements, earthworks and stormwater drainage; (b) Foul drainage and sewage disposal; (c) Water supply and distribution. Some site experience and possession of recognised technical qualification an advantage. Financial assistance and time off may be allowed for recognised courses of study. Promotion and pension prospects. Five-day week with 18 working days leave per year initially.

Salary ranges from £680 (at age 25) to £900 p.a. Commencing salary dependent on age, qualifications and experience. Applicants, who must be natural born British subjects, should write to AIR MINISTRY, W.G.c, LACON HOUSE, THEOBALDS ROAD, LONDON, W.C.1, or to any Employment Exchange (quoting Order No. Kings Cross 3746) giving age, details of training, qualifications, full particulars of former posts held and copies of any testimonials. Candidates selected will normally be interviewed in London and certain expenses reimbursed. G 840

GOVERNMENT OF CEYLON
DEPARTMENT OF AGRICULTURE

Applications are invited from suitable qualified candidates to fill the following three vacancies in Ceylon:—

(i) MECHANICAL ENGINEER, should be A.M.I.Mech.E. with 5 years' practical mechanical engineering workshop experience. Should have experience of repair and maintenance of heavy tractors, motor vehicles and allied equipment.

(ii) ELECTRICAL OR MECHANICAL ENGINEER, should be A.M.I.Mech.E. and/or A.M.I.E.E. with 5 years' or more practical experience in a mechanical and/or electrical repair workshop. Should be able to undertake repair and maintenance of Diesel Electric generating plant, Refrigeration Plant, Audio-Visual Aids, etc.

(iii) CIVIL ENGINEER, B.Sc. an advantage, A.M.I.C.E. essential. Should have at least 5 years' experience of design and construction of buildings in concrete and steel, road construction and maintenance, earthworks.

Candidates for the above posts should be not less than 35 years of age on 1st October, 1959, be of excellent moral character and physically sound.

Candidates should have first class administrative experience and ability.

TERMS OF ENGAGEMENT.—The appointments will be for 3 years in the first instance on a Provident Fund basis.

SALARY.—For Europeans: £1200-50-£1500 per annum. For Indians and Pakistanis: Rs. 15600-600-Rs. 18000.

Further particulars concerning allowances, quarters, passages, etc., and forms of application may be obtained on application to the High Commissioner for Ceylon.

Applications on the prescribed form should reach the HIGH COMMISSION FOR CEYLON, 13, HYDE PARK GARDENS, LONDON, W.2, on or before 15th January, 1960. A 931

EASTERN GAS BOARD
(AREA DRAWING OFFICE)
SENIOR DRAUGHTSMAN

Applications are invited for the position of SENIOR DRAUGHTSMAN in the Constructional Engineer's Department at Woodall House, Wood Green, N.22.

Applicants should possess a Higher National Certificate in Mechanical or Civil Engineering or similar qualification, and should be capable of designing and detailing steel and/or concrete structures. Previous experience in designing pipe work for the installation of Gas Works or Chemical plant would be an advantage.

The commencing salary will be within Grades A P T 9 to 11 (£862 to £1111 per annum) of the National Joint Council for Gas Staffs (Metropolitan) Salary Scales, according to qualifications, ability and experience.

The successful applicant will be required to pass a medical examination, and unless already subject to a Pension Scheme by virtue of the Gas (Pension Rights) Regulations, 1950, will be required, if eligible, to join the Eastern Gas Board Staff Pension Scheme within six months of taking up the appointment.

Applications giving age and other relevant particulars should be sent to the CONSTRUCTIONAL ENGINEER, EASTERN GAS BOARD, WOODALL HOUSE, 658, LORDSHIP LANE, WOOD GREEN, N.22, to arrive not later than 30th January, 1960. (Advt. No. 8.) A 935

UNIVERSITY OF CANTERBURY
NEW ZEALAND

Applications are invited for the following positions:

ASSISTANT LECTURER IN CIVIL ENGINEERING: Candidates should have the degree of Bachelor of Engineering (Civil) of the University of New Zealand, or its equivalent. Salary: £780 by £50 to £880 per annum.

LECTURER IN CIVIL ENGINEERING: Applicants should have a degree in Civil Engineering of a recognised University, teaching experience at a University, or have held a responsible position in a branch of Civil Engineering. Salary: £1025 by £50 to £1275 per annum.

In each case commencing salary will be in accordance with qualifications and experience. An allowance is made towards travelling and removal expenses.

Further particulars and information as to the method of application may be obtained from the Secretary, Association of Universities of the BRITISH COMMONWEALTH, 36, GORDON SQUARE, LONDON, W.C.1.

Applications close, in New Zealand and London, on 31st January, 1960. A 946

APPOINTMENTS OPEN

VACANCIES FOR
FIVE RESIDENT ENGINEERS

Applications are invited from Civil Engineers to supervise pipelaying contracts in Lanarkshire. The work would embrace setting-out, supervision of excavations in varying formations including rock, the laying in trenches of large diameter steel pipes with "Viking Johnson" couplings and other ancillary works, and the checking of contractors' interim certificates. It is anticipated that the appointments would be for about 18 months.

Applicants must be Corporate Members of the Institution of Civil Engineers, preferably with experience in similar works.

Salaries would be in the range £1200-£1450 per annum depending upon age and experience.

Written applications, with age and full particulars, should be sent to MESSRS. BINNIE, DEACON & GOURLEY, CONSULTING CIVIL ENGINEERS, ARTILLERY HOUSE, ARTILLERY ROW, WESTMINSTER, LONDON, S.W.1, not later than 11th January, 1960. A 914

VACANCIES FOR TWO
ASSISTANT RESIDENT ENGINEERS

Applications are invited from Civil Engineers to supervise pipelaying contracts in Lanarkshire. The work would embrace setting-out, supervision of excavations in varying formations including rock, the laying in trenches of large diameter steel pipes with "Viking Johnson" couplings and other ancillary works, and the checking of contractors' interim certificates. It is anticipated that the appointments would be for about 18 months.

Applicants must have passed Parts (*a*) and (*b*) of the Examination of the Institution of Civil Engineers and preferably have had experience in similar works.

Salaries would be in the range £950-£1050 per annum depending upon age and experience.

Written applications, with age and full particulars, should be sent to MESSRS. BINNIE, DEACON & GOURLEY, CONSULTING CIVIL ENGINEERS, ARTILLERY HOUSE, ARTILLERY ROW, WESTMINSTER, LONDON, S.W.1, not later than 11th January, 1960. A 912

WORK STUDY

A major industrial organisation requires a trained WORK STUDY ENGINEER with 3 to 5 years' experience in medium industry. The successful candidate must be able to work without detailed supervision and should also have some knowledge of mechanical handling. This is an interesting position and prospects are quite bright.—Please write stating full details of age, experience and qualifications to BOX A 950, Offices of ENGINEERING.

DESIGN AND DEVELOPMENT ENGINEER

DESIGN AND DEVELOPMENT ENGINEER required by small but progressive light engineering Company in Sussex manufacturing own precision products. Must have a sound knowledge of thermodynamics.—Apply giving full particulars of experience, age, and present salary to BOX A 963, Offices of ENGINEERING.

DEVELOPMENT DRAUGHTSMAN
DESIGNERS

PILKINGTON BROTHERS LIMITED, St. Helens, have two vacancies for DEVELOPMENT DRAUGHTSMAN DESIGNERS to work with the team which is developing Float Glass.

The work will be varied and interesting and due to the nature of the process will afford scope for initiative and responsibility.

Minimum qualifications H.N.C. Mechanical.

Applications should be addressed to GROUP STAFF DEPARTMENT, HEAD OFFICE, PILKINGTON BROTHERS LIMITED, ST. HELENS, LANCASHIRE. A 962

VACANCIES FOR TEN
INSPECTORS OF WORKS

Applications are invited from Inspectors of Works to supervise pipelaying contracts in Lanarkshire.

The work would embrace supervision of excavations in varying formations including rock, the laying in trenches of large diameter steel pipes with "VIKING JOHNSON" couplings, other ancillary works, the measurement of completed works and checking of contractors' interim certificates.

It is anticipated that the appointments would be for about 18 months work. Salaries would be in the range £750-£850 depending upon age and experience.

Written applications, with age and full particulars, should be sent to MESSRS. BINNIE, DEACON & GOURLEY, CONSULTING CIVIL ENGINEERS, ARTILLERY HOUSE, ARTILLERY ROW, WESTMINSTER, LONDON, S.W.1, not later than 11th January, 1960. A 913

MECHANICAL ENGINEERS

BP has vacancies for young MECHANICAL ENGINEERS for service with its Overseas Exploration Drilling Operations. Applicants up to 30 years old must have O.N.C. in Mechanical Engineering or equivalent and have served a five year apprenticeship with a diesel engine manufacturer with experience in fitting, turning and preferably some outside erection work with subsequent experience in operating and maintaining diesel engines. Experience of steam pumps, engines, boilers and refrigeration advantageous. Attractive salary plus generous allowance in local currency, free passages out and home, free medical attention, good leave arrangements. Kit allowance. Pension Scheme.—Write, giving full particulars, quoting F.582, to BOX 3218, c/o 191, GRESHAM HOUSE, E.C.2. A 930

MECHANICAL DRAUGHTSMEN

PILKINGTON BROTHERS LIMITED, Cowley Hill Works, have vacancies in their Drawing Office for Mechanical Draughtsmen. Applicants should have had experience in Plant Layout or Machine Design and should have a Higher National Certificate in Mechanical Engineering, or be working for it.

Applications should be addressed to the WORKS PERSONNEL OFFICER, PILKINGTON BROTHERS, LIMITED, COWLEY HILL WORKS, ST. HELENS. A 953

DRAUGHTSMEN

Vacancies have occurred for young men—versatile—as Engineering Draughtsmen in a Plastics Manufacturing Company. General experience required—Higher National Certificate desirable. A.E.S.D. rates and above. Good working conditions, contributory pension scheme. The factory is situated in pleasant country between Ipswich and Colchester, and within easy reach of the Essex and Suffolk coasts. Transport facilities are available from Ipswich, Colchester, Harwich and Clacton areas.—Applications should be made in writing to the PERSONNEL MANAGER AT BX PLASTICS, LTD., BRANTHAM WORKS, NR. MANNINGTREE, ESSEX, stating age, qualifications and experience and career to date. A 944

TECHNICAL AUTHORS

fully experienced in all aspects of compiling industrial and services manuals required for West London Company manufacturing wide range of Electronic equipment. Techniques include pulse, A.M., F.M. and transistor application.

TECHNICAL EDITOR

also required for the preparation of technical reports from notes supplied by laboratory engineers. Electronic background essential. The reports, which include illustrations, are for submission to customers and need to be of appropriate standard.

THESE ARE ALL SENIOR POSITIONS CARRYING COMMENSURATE SALARIES

Free Life Assurance and Contributory Pensions Scheme

Applications (in strictest confidence) to BOX A 933, Offices of ENGINEERING.

A CONTRACTS ENGINEER

FOR PUMP DEPARTMENT

is required by

W. H. ALLEN SONS & CO., LTD.

QUEENS ENGINEERING WORKS, BEDFORD.

The appointment is a responsible one, involving the handling of projects, tenders and contracts for complete pumping schemes. Applicants should have served an apprenticeship and reached at least Higher National Certificate standard, with experience in either drawing office, commercial department, plant-operation or manufacture.

Good staff Pension Scheme; assistance towards removal expenses.

Apply, stating age, experience, present salary, etc., to **THE PERSONNEL MANAGER** (quoting Ref. No. CA.202). A 942

CHIEF ENGINEER

An international consumer goods manufacturer, acknowledged leader in its branch of industry, wishes to make a high level appointment in engineering management.

The Company has reached its present outstanding position in the United Kingdom through steady, continuous expansion, and it is planning for further development in which the co-ordination of many technologies must play a vital part.

Substantial advances have recently been made in the provision of additional production capacity and the installation of modern plant and equipment.

The Chief Engineer will be responsible to the Director of Engineering for all aspects of the Company's diverse engineering activities—mechanical, electrical, constructional and industrial.

The most important requirement is proved ability and experience in leading qualified men and co-ordinating the work of different specialised groups. Candidates must be able to show evidence of this, almost certainly in terms of a previous industrial management post. They must also be fully qualified in one or more engineering fields, and experienced in negotiating with consultants and public authorities. Finally, they should be at least 35 years of age, and earning more than £2000 p.a.

The location of the appointment is London, and terms of employment will be appropriate to the high importance attached to it.

Please write fully to BOX A 958, Offices of ENGINEERING.

Experienced Graduate Engineers

are required by

the manufacturers of the widest range of plastics raw materials and semi-finished products in the Commonwealth.

The Plastics Division of Imperial Chemical Industries Limited is now expanding its Engineering Department in order to keep pace with growing sales in home and overseas markets. Enquiries are invited from:—

Mechanical and Chemical Engineers

holding first or second class honours degrees with some years of industrial experience.

The Division is looking for men of energy, initiative and proved ability. Good starting salaries will be paid immediately, and prospects for the future are excellent. The individual projects upon which candidates will be engaged vary in character and involve all types of engineering, from light precision machine work to heavy process. They include all the planning, layout and procurement associated with the design and erection of large manufacturing units. Some of the work is experimental, directed towards manufacture in new fields.

Conditions of service are good and pension and profit-sharing schemes are in operation. For married men, temporary lodging allowances are available and assistance is given towards house purchase and removal expenses.

Apply briefly to:—

The Staff Manager,
Imperial Chemical Industries Limited,
Plastics Division,
Black Fan Road, Welwyn Garden City,
Herts. A 943

PRECISION ENGINEERING DEVELOPMENT

A well-known precision engineering company, with laboratories in West Middlesex, is expanding its Development Department and requires **TWO SENIOR ELECTRO-MECHANICAL ENGINEERS** with several years experience in the development of equipment through all stages from the original idea to the production design.

Applicants must possess a degree, or equivalent, and have a good general knowledge of small electro-mechanical devices. For the first vacancy experience of small d.c. or a.c. electric motors is desirable; for the second, some experience of thermostats and related equipment would be an advantage.

These appointments are pensionable and removal expenses would be refunded. Starting salaries not less than £1000 p.a.

Write, giving full details of age, qualifications and experience to: CHIEF ENGINEER, BOX A 870, Offices of ENGINEERING.

DEPUTY PRODUCTION ENGINEER

Required for a medium-sized company manufacturing specialised equipment for the vehicle and motor car industries.

The Deputy Production Engineer will be responsible to the Production Engineer for the supervision of engineering staff covering process planning, work measurement, tool design and manufacture.

Candidates, who should have professional qualifications in production and mechanical engineering, must have extensive experience of modern machine tools, process planning, jig and tool design and work study in the light mass production engineering field.

Experience in the design of special purpose transfer machines would be an advantage.

Age group—30-45. Four-figure salary and non-contributory pension scheme. Please send full details of career in confidence, quoting reference LRM/PE.1, to **CLAYTON DEWANDRE COMPANY LIMITED, TITANIC WORKS, LINCOLN.**

A 858

MECHANICAL ENGINEER

with senior status required for research and development work in Manchester. Honours degree, good knowledge of thermodynamics, metallurgy experience with design calculations of various kinds of thermal plant essential.—Apply

KENNEDY AND DONKIN, 12, CAXTON STREET, LONDON, S.W.1

or

64, ROYAL EXCHANGE, MANCHESTER.

A 929

PORTLAND BLUE CIRCLE CEMENT

DRAUGHTSMEN

required by

ASSOCIATED PORTLAND CEMENT MANUFACTURERS LTD:

to work in Area Engineer's Office, Stone Castle, Greenhithe, Kent, on drawings for the installations of new plant on a long term basis. Profit sharing and pension schemes in operation. Applicants, who should have some experience in bulk mechanical handling, should apply in writing stating training, qualifications, experience, age and salary required. A 926

ADVERTISEMENT RATES

'Engineering' Appointments Section

CLASSIFICATIONS: Public Appointments, Appointments Open, Appointments Wanted.

TYPES OF ADVERTISEMENTS:

(a) "Appointments Illustrated" and illustrated careers advertisements: photographs or drawings may be used in conjunction with type matter.

Rates: per page (12 in. by 9 in.)	£100
per half page	£54
per quarter page	£29

(b) Semi-display: type matter, with or without surrounding rule, name block or symbol.

Rates: per page (12 in. by 9 in.)	£100
per half page	£54
per quarter page	£29
per single column inch	£2 14s.

(c) Single column "run-on" advertisements: approximately 6 words to the line, 12 lines to the inch.

Rate per line (Minimum charge 18s.)	4s. 6d

SERIES DISCOUNTS: 5 per cent. on 6 insertions; 10 per cent. on 13; 15 per cent. on 26.

BOX NUMBER: 2s.

Company Meetings

Quarter page £29 : half page £54 : full page £100

COPY DATE: First post Monday.

BLOCKS: To be mounted ready for printing. Screen 100.

ORDERS TO: "Engineering," 36, Bedford Street, London, W.C.2 Telephone TEMple Bar 3663).

COMPANY MEETINGS

J. BROCKHOUSE & COMPANY

SUBSTANTIAL GROWTH IN VOLUME OF ORDERS AT YEAR-END

MR. J. L. BROCKHOUSE ON JUSTIFICATION FOR MEASURE OF OPTIMISM

The 62nd annual general meeting of J. Brockhouse & Company Limited was held on December 17 at West Bromwich, Mr. J. L. Brockhouse, M.A. (Chairman and Managing Director), presiding.

The following is his circulated statement:

Ladies and Gentlemen, It was not until the last quarter of the financial year that the General Engineering Trade began its upward trend, and the impact of this is not reflected in this year's figures to any measurable extent, in fact during the early part of the year one or two important Sections of our plant were employed well under capacity. In addition it was thought fit to make substantial stock reserves in an overseas Subsidiary Company. It is therefore satisfactory to be able to report a modest increase in the profit for the period. I am pleased to say that in the last four months the general volume of orders has shown a substantial increase and there are indications that this will continue, and therefore a cetain measure of optimism is justified.

New Developments

I said last year that some of our new developments were beginning to bear fruit, and there are one or two which I feel deserve particular mention. We have for many years been engaged in the design and supply of light steel structures, and the ideas which we have evolved have been incorporated in a system of building which is finding an increasing acceptance. This system has been fostered by a number of Educational Authorities and the results have been so successful that certain Ministries have adopted it and other Statutory Bodies are employing this type of building for office accommodation, canteens and similar purposes.

We have also achieved a very substantial measure of success in the oil burning field. Our efforts in the main have been directed towards the automatic and efficient burning of the heavier grades of oil, and the results obtained by this Department are very satisfactory, both financially and technically.

Growing Reputation of Products

I am pleased to report that our Hydraulic Transmissions are receiving a wider recognition. We have concentrated on what is termed the industrial field, that is fork lift trucks, earth moving equipment, locomotives and the like. It is, as you might well appreciate a highly technical and consequently expensive development, but the reputation of our products is now being appreciated, not only in this Country, but in many countries abroad, and we are supplying quite large numbers to the Continent of Europe, including Western Germany as well as to the more traditional markets.

During the year we made an agreement with Associated Motor Cycles Limited, whereby they purchased from us the Motor Cycle Division of the Indian Company of Springfield, Massachusetts. This was originally purchased when your Company was manufacturing motor cycles at Southport. The name of The Indian Company has now been changed to Brockhouse Corporation, the only Division of which is the Donnelly Manufacturing Company of Waltham, near Boston, which since its acquisition has shown consistent profits.

Plant Closed Down

We have for some time been aware that the change of the type of Buffers required by the Railways would deprive Lones, Vernon & Holden Limited of its major operation. During 1959 this plant has been closed down and the old mills for rolling buffer rods have been scrapped. The production of taper bars, which was the only other product of this Company has been transferred to the District Iron & Steel Company Limited. Lones, Vernon & Holden Limited was the first Subsidiary Company to be acquired by J. Brockhouse & Company Limited, and it was naturally with regret that it was found that this step was necessary, but at the same time it is a part of the general progress of the whole Organisation.

We have recently made an offer for the Ordinary Share Capital held by outside Shareholders in our South African Subsidiary Company, J. Brockhouse (South Africa) Limited. At the present time we hold 67·3 per cent. of the equity and we have taken this step because the policy of a Group such as ours does not always coincide with the interests of the minority Shareholders in a Subsidiary Company, and further, any additional capital required must in practice be found by the Parent Company. This Company has had a successful profit record for the past five years, and has proved a worthwhile investment.

The Current Year

In view of my previous comments on the general increase in the volume of business, we can reasonably expect to show an improved trading result for this current year. It should of course be remembered that your Company's activities are, in the main, in a highly competitive field, and therefore the margin of profit is not spectacular and depends on the full and efficient use of its plant. We shall during the next year or two be spending an increasing amount on replacements and improvements to our plant, which is necessary if we are to remain competitive and take advantage of the increased business which is offered.

I do not usually comment on the figures presented to you in any detail, as I feel these are very clearly set out. You will no doubt have noticed a very marked improvement in our cash position, and this will enable us to finance this additional capital expenditure, and I hope prosecute further development.

Directorate

I must also refer to the death of Mr. Frank Brockhouse in May. He joined the Company virtually at its very beginning and remained with us until his retirement from the Board on the 21st December, 1955.

During the year we were glad to welcome Mr. Arthur Chamberlain to the Board of Directors. Mr. Chamberlain is well known to Midland Industry, and we consider ourselves fortunate that we now have the benefit of his advice and experience. I hope this will be the beginning of many years of his successful association with this Company.

We are also very happy to see Major Dibben here, and to know that he is recovered from the very serious motor accident he suffered in March of this year.

On the 30th June, Mr. Ernest Crosse, an Executive Director, retired from the Company on reaching the age of sixty-five years. I should like to take this opportunity to thank him for his service to the Company. He joined us in 1946 as General Manager of Victoria Works, and was responsible for the re-organisation of this important Section of our activities during the difficult post-war period.

I should once again like to record the Board's appreciation of the loyal service given by the General Managers, the Staff and Workpeople. We are fortunate in this Company in that we have not suffered from any industrial dispute and I think this is largely due to the mutual confidence that exists.

The Report and Accounts were adopted. A 949

Companies

And after Nestlé

The battle between Nestlé Alimentana of Switzerland and Fisons for control of Crosse and Blackwell (Holdings) Limited has a significance a great deal wider than the grocery trade.

Any precise list of the products of Crosse and Blackwell, canned soup, beans and peas, confectionery and pickles can be seen to conflict very little with a list of Nestlé activities, condensed milk, chocolate, Nescafé, canned soup and baby foods. But Switzerland is now a member of the European Economic Community (the Six), possession of Crosse and Blackwell would put the £323 million Swiss firm in the centre of the European Free Trade Area (the Seven) and also of the Commonwealth. This, and not merely an opening manoeuvre in the canned soup war may well be what is in the minds of the Nestlé directors, as it may be in the minds of industrialists in other fields than food.

Why the Fison's bid? Crosse and Blackwell have a renowned marketing organisation, one of the public manifestations being the ten o'clock tested advertising shorts on commercial television. Fisons have in their Milk Products Division the newest subsidiary in Britain and a section that would stand to gain enormously from the marketing skills of Crosse and Blackwell. Similarly in Benger's Food Fison's have a milk drink that is tiny in comparison with the leaders in the field, Horlicks and Ovaltine, but heavyweight marketing programmes have not been applied.

An important part of Fison's organisation, even though to the public the company may be Fison's the fertiliser people, is pharmaceutical. It is one of the possible, and somewhat wry conclusions that may emerge, that should Fison's gain control of £11 million Crosse and Blackwell one of the everyday changes of the 1960s could be the invasion of the grocers' shops by products still associated with the chemist. But Nestlé could yet counter-bid.

Hovercraft Echo

After the massive reports of the main motor manufacturers, the annual statement of Mr. J. J. Parkes, F.R.Ae.S., chairman of Alvis, deals in relatively small figures. He is able to report an increase in the net profit of £29,814 over the year before to £230,612.

The Alvis firm is diversified right up to the top. During the year the Hovercraft SRN 1, crossing the English Channel in a whirl of spray and publicity, was blazing its particular trail with one of the Alvis Leonides engines. The Leonides Major, already widely used in the Navy, was selected for the Whirlwind helicopters now added to the Queen's Flight. A small but steady increase in the demand for these engines is forecast by Mr. Parkes.

On the military vehicle side the Alvis chairman differs from other leaders in the industry by reporting sustained orders. The Saladin armed car continues to improve its popularity with the British Army and the Saracen remains the standard personnel carrier. Of the company's luxury Alvis car, the chairman observes that it has "adequate speed and performance" for safe touring on motorways.

Several times in the year the company had had to refute inquiries as to whether it was being made the subject of a take-over bid. Mr. Parkes advises stockholders to ignore speculative reports on the subject.

Timken into Fafnir

A change in ownership of one of the best-known British ball and roller bearing firms takes place from today.

It is the Fischer Bearings Company of Wolverhampton, who become part of the organisation of the Fafnir Bearing Company of the United States and are now known as the Fafnir Bearing Company.

Fischer Bearings, formerly a Timken subsidiary, were set up in 1936. By a happy coincidence of initials they will be able to go on using their FBC trade mark and, one of the company's officials told ENGINEERING, two other trade marks, including the mark Fischer, will continue in use. Certain distribution arrangements now in force will also remain for the present.

The Fafnir concern in the United States employs some 6,000 people in six bearings manufacturing concerns, while in Britain FBC has some 1,500 employees.

The chairman of Fafnir, Mr. Standley M. Cooper, has assumed the chairmanship of the British subsidiary and is seeing the changeover through.

Knocking out Mills

In the 200 mills of the Lancashire cotton belt where the machinery has to be scrapped beyond repair by March if the owners are to get a share of Government compensation, demolition workers have taken the place of charge hands and mill girls.

Much of the work has been organised by Thomas W. Ward, the Sheffield industrial group and scrap dealers. They have worked out a system in which foremen from Sheffield travel with rather simple equipment—hammers and crowbars—to the mill, recruit enough labour locally, and then set about reducing the machines, some of which have been running with smooth perfection for up to a century, to cast-iron, steel, brass, copper and aluminium.

While the machinery is going, most of the mills are not. Magnificently built, often with immensely strong walls, the mills are turning out to be curiously versatile. One has been bought by a football pools firm, another for a beer warehouse, and one, near Bolton, for the intensive rearing of tens of thousands of chickens.

Tigers and Trains

From lifelike model elephants to a model Cotswold pub, and from Canada to Australia the 21-company Lines group is expanding at a pace only equalled by the speed at which its designers have to work to keep up with the insatiable appetite for detail shown by the children.

In Britain, Rovex, the scale-model makers at Margate have brought into use a third expansion to their plant. A new factory is being built at Canterbury for the transfer there of Minic, from Merton in south London. Among children, lively excitement has been shown over the introduction of the Spot-On 1/42 scale models and the result at Belfast where they are made has been considerable expansion of the works and the labour force. Lines Brothers (Ireland) also produce the Lines Zoo, which ranges from tiny plush animals up to what the chairman of the famous toy firm, Mr. Walter Lines, describes as "great big lions and tigers." The booming Lines works in Northern Ireland are one bright spot in the generally gloomy employment picture of that area.

Common Market proposals are of as much concern to Lines as to firms who have more exclusively adult customers. Establissements Guy S.A., at Givors, near Lyons, became a subsidiary in 1958 and it is on this plant that much of the Lines' hopes of future sales expansion in Europe is based. In Germany, Lines Brothers (Deutschland) GmbH has been set up as a marketing organisation.

Further afield the group has a Canadian subsidiary, active right across the dominion and also selling toys made in Britain. In Australia, Cyclops & Lines are going ahead so rapidly that a start may soon be made in building on the 10½ acre site recently bought to add to the present factory.

Refinery Case History

The story of how a new 20,000 barrels a day refinery was designed and built at Port Moody in British Columbia is told in the autumn issue of *Kelloggram*, the journal of the M. W. Kellog Company, New York City. The whole operation was planned jointly by Kellogg and their client, British American Oil Company Limited. Great emphasis is placed on the team work which made possible the completion of the whole project in less than 22 months, from the time Kellog were first approached in February, 1957, to 1 January, 1959, when the refinery was on stream.

Kellog's terms of reference specified "new capacity at low cost per barrel in a plant which would be economical to operate and which would pay out quickly." The cost per barrel of refining capacity was about $1,000, which is believed to be the lowest investment figure for a 20,000 barrel a day refinery built in the Western Hemisphere. The objective of the designers was a plant suitable for expanding markets with the flexibility to meet changing needs. The result was a combination of processes able to give the desired proportion of high octane fuel to residuum, with the possibility of easy expansion to provide for a varied proportion of these fuels. The process set up consisted of combination crude topping and vacuum distillation, Orthoflow fluid catalytic cracking, distillate and naphtha desulphurisation, catalytic reforming, and sulphuric acid alkylation, supported by a crude and product storage capacity of 1·29 million barrels.

One of the features of the project was the avoidance of either straight fixed price contract or the formula of open costs plus fixed fee. A fixed price contract was drawn up but only when the refinery project had been fully defined in detail. Both parties were therefore well informed as to what was likely to develop and Kellog's took their risk with full knowledge of the facts.

Bids and Mergers

Somewhat unusual action on the part of six of the country's leading shipbuilders led to the acquisition of Brown Brothers and Company of Edinburgh, the hydraulic and marine engineers who have won an international reputation since the war through the development and manufacture of the Denny Brown stabiliser. Brown Brothers also make ships' steering gear, marine catapults and other marine engineering products.

The consortium, on whose behalf Philip Hill, Higginson, Erlangers negotiated the deal, comprises John Brown and Company (Clydebank), Cammell Laird, Fairfield Shipbuilding and Engineering, Harland and Wolff, Swan Hunter and Vickers. Although none has yet commented on their reasons for the purchase it is evident that the further development of the stabiliser is very much in the interest of British shipbuilding, and that it would have been against the industry's interest had the company been acquired by someone else, a real possibility in view of the world wide use of the Denny Brown equipment.

Another merger announced recently concerns Baker Perkins Limited, the leading manufacturers of bread, biscuits, confectionery and other food machinery, and William Douglas and Sons Limited, of Putney, London, who were founded in 1888 and have specialised in industrial refrigeration plant, which remains their basic line. The Baker Perkins group will acquire the refrigeration, bulk handling and general engineering business of Douglas, who will be known as William Douglas and Sons (Engineering) Limited. The assets used in the engineering activities of the present Douglas company will be transferred to the new one. Douglas and Baker Perkins have been associated technically and commercially for some time. Many Baker Perkins plants in biscuit and other food factories incorporate Douglas equipment for the automatic handling in bulk of the fats and liquids used in production.

Aluminium Developments

There has been a definite upturn in the demand for aluminium products in this country although the world picture of the industry is less encouraging. "It is likely to be quite a time yet before the considerable over capacity is taken up," said Sir Ivan Stedeford, chairman of Tube Investments Limited, in his annual statement. Seven months trading of BA and of Reynolds TI Aluminium are included in the £12·6 million profit of the group as a whole for the year to 31 July last, about the same as the previous year, but in fact some 10 per cent less if the figure is "adjusted for comparison as nearly as possible," due to reduced turnover and margins.

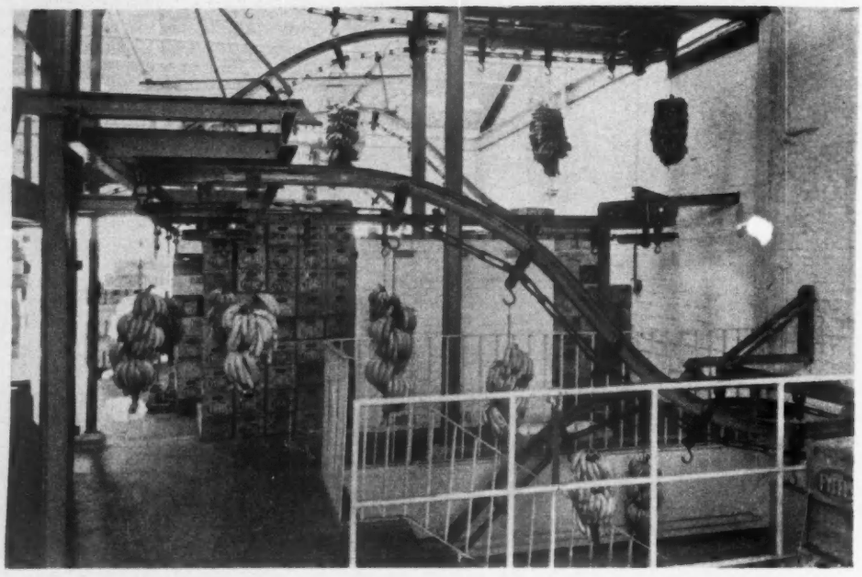
More definite signs of recovery are exhibited by some of the smaller firms due to a rise in the demand in most of the metal markets.

The Banana Business is Ripening

Some 50,000,000 bananas are eaten every week in Great Britain. According to Board of Trade figures, consumption in 1958 was more than twice what it was ten years previously, when fresh fruit and vegetables were beginning to be imported again in greater variety. By the time all these bananas have reached the shops they have usually developed the familiar golden yellow colour showing that they are ripe and ready for eating. This is no coincidence, but the result of careful control during storage, designed to synchronise supply with demand.

The latest ripening technique is exemplified by a new banana warehouse which has been completed for Elders and Fyffes Limited, at the British Railways goods yard at North Kensington. It is, in fact, a conversion of an existing building, the interior of which has been completely stripped and re-equipped to modern standards. The capacity of the building allows for some 13,000 bunches of bananas.

Green fruit is brought in from overseas by a fleet of Elders and Fyffes's own ships. On arrival at Liverpool, Southampton or Bristol docks, the bunches are unloaded into special trucks and transported by rail partly to the firm's warehouses and partly to the ripening rooms of the wholesalers. Normally, the fruit takes between four and five days to ripen under controlled heat; after which the bananas are cut from the bunch, weighed, labelled and packed into 28 lb cases for delivery to retail shops.



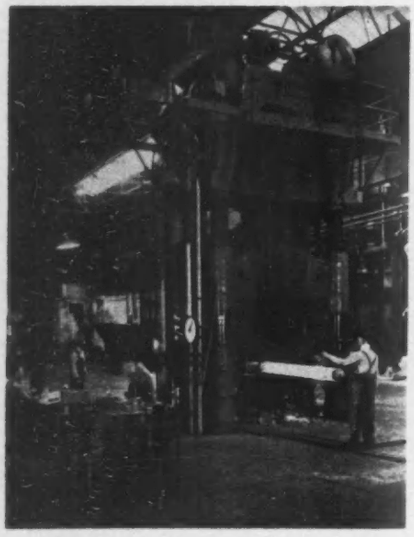
Overhead chain conveyor on which bunches of bananas are carried to and from the ripening rooms.

The new warehouse contains a number of rooms of varying sizes where bananas are ripened at pre-arranged temperatures. Each room, which is fed by an overhead chain conveyor serving the whole building, is equipped with a two-speed reversible fan totally enclosed and having an air displacement of 680 cubic feet per minute. In addition, there are four 18 in high level fans, each with a displacement of 2,150 cubic feet per minute. There are a number of controlled gas-heating units and nine thermostatically-controlled overhead heaters to maintain the background temperatures throughout the building. The overhead heaters are used in conjunction with the central heating plant.

The electrical installations of the building required about 16,240 yards of cable. Polythene-insulated pvc sheathed cables, with watertight fittings for lighting, are used in the ripening rooms because experience has proved that cables in conduits deteriorate rapidly in the conditions of extreme humidity and high temperature found in these rooms. For the general installation, cables have been drawn through screwed conduits in the usual manner, and for this purpose pvc insulated cables were selected. The mains supply has been picked up from the intake position and run through $1\frac{1}{2}$ in screwed conduit with taped, braided and compounded cable to the main switch frame in the store. British Insulated Callender's Cables Limited supplied all the cabling for the lighting and power installations in this new warehouse.

800 ton Press Automatically Controlled

A forge development scheme, started by Thomas Firth and John Brown Limited of Sheffield in 1953 with the purchase and installation of a 1,750 ton press with all the necessary furnaces including a 15 ton rail-type manipulator, is now reported to be working satisfactorily. Following the completion of the 1,750 ton scheme, another press shop was built for the installation of a new 800 ton press, equipped with a 3 ton mobile manipulator, and with furnaces of modern design. This press is now being fitted with automatic precision control.



The 800 ton press with its associated control desk.

The 800 ton press, which is 26 ft high, exerts its force through a ram supplied with water at a pressure of 4,250 lb per sq. in. The daylight or clear opening of the press is 9 ft and it has a working stroke of 4 ft. The crosshead which carries the top tool can exert the full 800 ton force at a steady speed of between 6 and 8 in per second. It can alternatively be made to give light planishing strokes at the rate of 120 per minute to finish the surface of the material under the press.

The press is controlled by an operator at a control desk which operates servo-operated control valves to give finger tip operation with accurate and sensitive control. As well as considerably reducing the physical effort required of the operator, this method of control allows the rate of carrying out quick forging strokes to be considerably increased. The power to the press is supplied from three-throw horizontal pumps driven by 550 h.p. electric motors. They deliver 132 gallons per minute of fluid at a pressure of 4,250 lb per sq. in to a set of air-hydraulic bottles which form a reserve accumulator for the system.

The billets are heated to between 1,150° and 1,250° C in six furnaces arranged by the side of the press. The furnaces are fitted with a system of automatic temperature and pressure control which automatically brings the billets to the precise temperature required. When this temperature has been reached the material is withdrawn from the furnace on the bogie on which it has been riding and it is picked up by a 3 ton manipulator driven by a diesel engine and weighing 20 tons. The manipulator takes the work to the press where the operator and manipulator driver work in conjunction under the direction of a forgeman to shape the ingot to its final shape and size.

If an extra long forging is to be handled under the press, then the manipulator is assisted by a 10 ton crane, which carries the end of the forging on the opposite side of the press to the manipulator, thus supporting the outer end of the forging. The turning-over gear carried by the crane operates a Burden chain round the forging.

As an indication of the work involved in these press installations, it is worth recording that over 2,000 cu. yd of spoil, weighing some 3,000 tons, were excavated for the foundations of the 800 ton press and its furnaces. About 1,200 tons of concrete were placed for the press foundations, together with 2,000 tons under the furnaces.

The next stage in the scheme involves the installation of a new 4,000 ton press which is to be set up in newly acquired premises. The furnaces in the new shop were of the old hand-fired type, and conversion of these to the most modern type of producer gas furnaces will be completed by the time the press is ready for work.

Working a Standards Department

The British Standards Institution has published a booklet on how to run a standards department. It is a guide to the principles and practice of applying standards in the individual firm and is called *The Operation of a Company Standards Department*. It should be of interest to almost every industrial and purchasing organisation in the country.

The introduction to the booklet indicates some of the obvious sources of savings resulting from the efficient use of standards, such as reduction of stocks, ordering of larger batches, elimination of design and tooling costs for special components, and reduction of storekeeping and inspection overheads. It makes the point, however, that an exact evaluation of such savings is difficult to make if not impossible. The guide goes on to describe the principal functions of a company standards department, such as the compilation of standard books and the provision of an information service. The use of British Standards, in formulating company specifications, is indicated.

An outline is given of the fields covered by company standards and variety reduction. The easing of production problems resulting from standards collaboration between design office and factory floor is emphasised. Advice is next given on the actual writing of company standards in the light of such practical questions as "can the articles specified be obtained at the right price and in the required quantities, and at the right time?"

Emphasis is laid upon the necessity for full cooperation between the standards engineer and other departments in the company. The importance of classification and coding in standards work is explained and the general principles are outlined. Guidance is given on methods of reproduction and distribution of company standards, and the layout and headings for a model standard sheet are given.

Enamelling Aluminium

The Aluminium Company of America claim to have the world's widest roller coating equipment for enamel coating aluminium sheet. The unit was recently installed at the company's Alcoa sheet mill in Tennessee. It is producing aluminium alloy sheet with coloured enamel finishes in thicknesses between 0·019 and 0·051 in and in widths up to 60 in. The maximum width available previously was 42 in. The product is pretreated and enamelled in a continuous cycle, and its cost is lower than that of traditional spray painted sheet.

Coiled sheet is fed into the unit and passes through a surface preparation section to make sure of good adhesion between enamel and metal. It then passes through the roller coater applicator which simultaneously finishes both sides of the coil. The final treatment sends the sheet through a controlled battery of baking ovens which are claimed to give the sheet a good resistance to chipping, flaking, blistering and cracking.

Machine Tools, Education and Research

The Machine Tool Trades Association and the Department of Scientific and Industrial Research are continuing their discussions of the action to be taken as a result of the DSIR survey of the research and development requirements of the British machine tool industry. At the most recent meeting, at which representatives of the Ministry of Education were present, two major subjects were discussed: education and research.

On education, the representatives of the industry concurred in the view of the Ministry of Education that the existing education and training facilities for students proceeding beyond Higher National Certificate level could be more fully used, and that more specialised courses were also necessary. There was a need for both more students and more teachers. The Ministry representatives invited the industry to assist in reviewing the curricula of existing courses and in devising any necessary new courses.

So far as research was concerned, the meeting noted that DSIR grants for research in the field of machine tool technology had already been made to two universities and that others were under consideration. It was also noted that exchanges of visits between research engineers from the National Engineering Laboratory and engineers from machine tool firms had taken place. More were being planned. While appreciating the advantages of making more use of existing facilities for research, the representatives of the industry undertook to give further consideration to the type of research organisation most suited to the needs of industry, on one hand, and the research work of universities, colleges and research institutions, on the other.

Ship Built in 30 Weeks

At the recently modernised shipyard of Charles Connell and Company, Limited, at Scotstoun, Glasgow, a ship has been completed in 30 weeks. The ship is the motorship Craigallian and it is intended for ore-carrying duties. Its deadweight is 9,550 tons.

The first double bottomed section of the new vessel was laid on the building berth in the week beginning 4 May, the launch took place on 2 October which, allowing for two weeks holiday, is a period of 20 working weeks, and the trial trip took place on 10 December—ten weeks after the launch.

The company hope, by this production rate and with new equipment coming into use with their 65,000 ton berth and 60 ton crane for prefabricated units, to meet the intensive competition now being faced by the shipbuilding industry. They have now laid the keel of their largest vessel to date, a tanker of 37,000 tons deadweight.

Cutting the cost

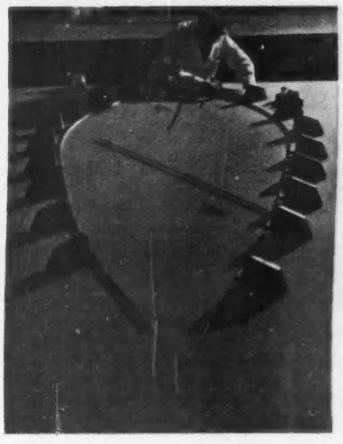
The somewhat forbidding title of *Improved Material Utilisation* almost frightens one away from what is a very interesting and useful booklet published recently by the Institution of Production Engineers. The research committee of the institution, following the publication of their report *Material Utilisation in the Metal Working Industries*, decided that similar investigations relating to other materials should be made. Consequently a new sub-committee was formed and given the following terms of reference: "To investigate, within the specified fields, the use of raw materials in the engineering and allied industries, and other production processes."

The booklet, which is the result of these investigations, is divided into four main sections under the following headings; finishes and finishing materials; packaging and shipping materials; ceramics; metal powders and plastics; and ancillary processing materials. In these sections, there are listed a number of case histories, typical of which is one in the third section of the report. This study is concerned with a pair of drill jigs for drilling holes in side mouldings of a car body. The old jigs were of the conventional type in that they were made of steel. The estimated cost of using this method is given as £400. The new method employed glass fibre jigs with steel bushes costing £60: thus saving £340. There are some 80 more similar case studies quoted, all designed to stimulate interest in the economic use of materials industry. At the back of the booklet there are listed two and a half pages of conclusions.

Full Size Plans of Aircraft

Layout draughtsmen of Short Brothers and Harland are drawing the full-scale plans of the SC 5 Britannic freighter on metal. The process is similar to lofting, and is derived from traditional shipyard practice of preparing full-scale drawings in a loft—the only place where there is enough room.

The work is carried out on the tops of tables, the largest of which measures 120 ft by 20 ft. The dimensions of the aircraft are such that the men have to do most of the work while kneeling on the table tops. From the master drawings which are made, duplicates are turned out lithographically on metal for the manufacture of templates which are used by machine tool operators when producing the Britannic components. The work of this department also verifies the shapes and contours of the different components after the initial design has been established.



Full-scale plans for the Britannic.

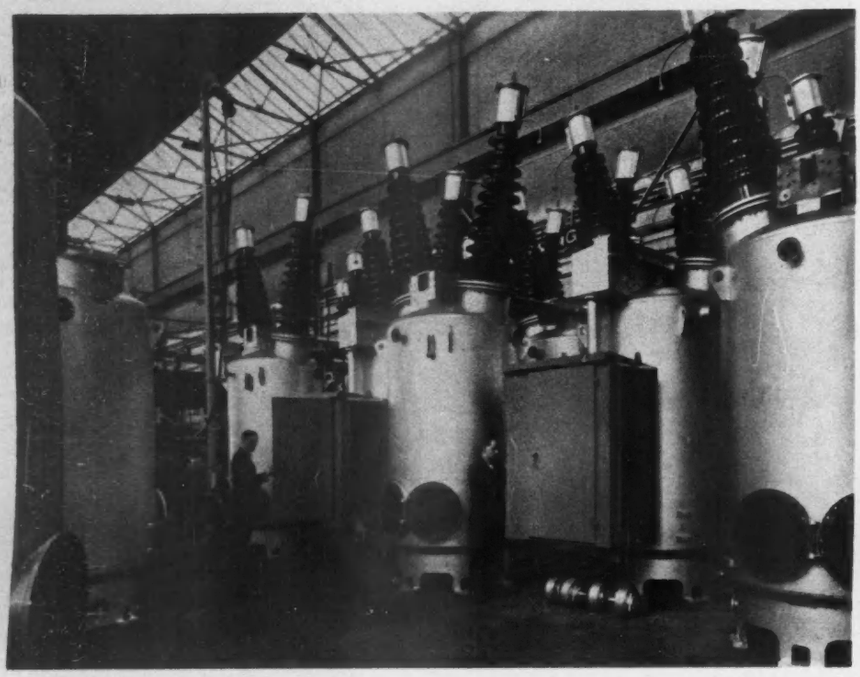
The process of full-scale lofting was introduced into the aircraft industry during the Second World War and it has been used since by Shorts on all their major design projects including the Solent, the Sperrin, the SB 5, the military Britannia, and the SC1 VTOL aircraft.

Twist Drills Standardised Internationally

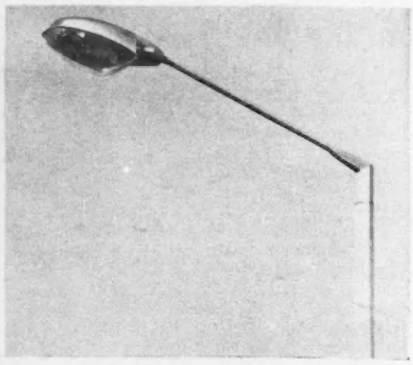
As from 1 January the general dimensions of twist drills will conform with the International Standard Organisation's recommendation No. 301, if everyone conforms with BS328: Part 1, 1959. After many years of study, a technical committee of the ISO representing 14 countries has reached agreement on recommended flute and overall lengths for standard types of twist drills. In comparison with existing national standards, the new ISO recommendation has a more systematic diameter to flute length ratio, giving a more balanced relationship between diameter and flute lengths.

The new drill lengths provide a more efficient twist drill, able more easily to accommodate the high torques and thrusts associated with modern drilling practice; furthermore, the possibilities of drill "wander" are reduced. The more systematic diameter to flute length ratio should give a more consistent performance relationship between drills in adjacent length groups than hitherto.

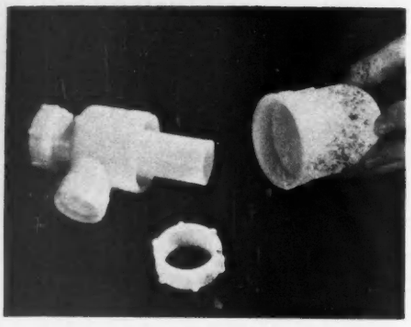
The ISO committee were of the opinion that most applications of the larger sizes of taper shank drills do not demand flute lengths as long as those in previous standards, and the shorter drills will be more sturdy, thus reducing vibration during drilling.



(Above) British Thomson-Houston 132 kW oil circuit breakers for the Agua y Energia Electrica power station.



(Above) Alpha III mercury fluorescent lantern designed by Atlas Lighting for built-up areas.



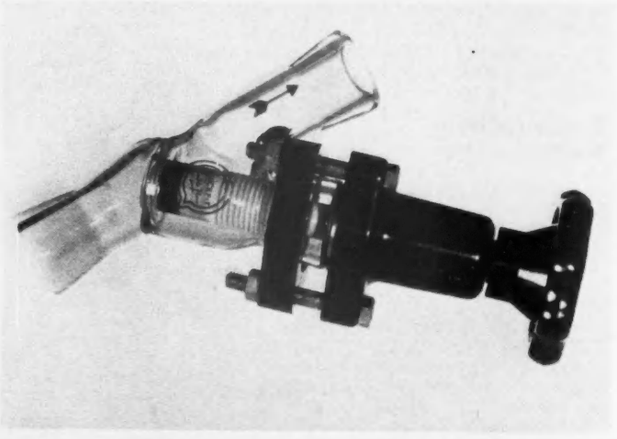
(Right) Waste traps by McAlpine of Hillington, Glasgow, from Rigidex high density polyethylene resist frost and boiling water.

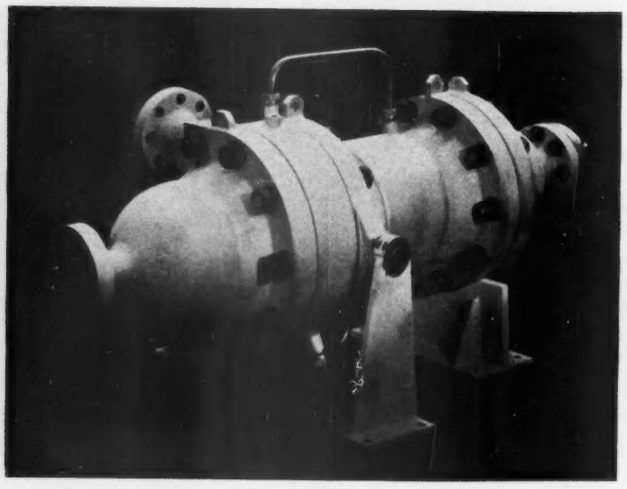
(Left) Type F plug valve produced by Langley Alloys.

(Right) QVF screw type glass valve for use with corrosive liquids.

(Below left) Key-Conex waste connector (Key Engineering).

(Below right) Ruston and Hornsby coolant circulator with gas bearings for the Advanced Gas Cooled reactor at Windscale.





No Propeller or Rudder on Jet Driven Boat

There has long been a need for an alternative to the screw propeller, which is vulnerable to damage and a danger to swimmers, divers and water skiers. The Dowty Turbocraft has neither propeller nor rudder but is propelled by a two-stage jet.

A boat without a propeller or rudder, the Turbocraft (Figs. 1 and 2), has been designed by Dowty Marine Limited, Cheltenham Road, Staverton, Gloucester. The glass fibre construction used for the hull, deck seats and engine cover gives the structure a high strength-to-weight ratio. It is impervious to all in-or-out-of water conditions and easy to maintain. The skin and wall of the hull and deck contain colour pigment throughout and so do not need painting.

The design of the hull, with its 10° deadrise at the after planing surfaces, is one of the reasons why the boat can turn in its own length at top speed. Since there are no underwater appendages, the boat can operate at high speed in water only 4 in deep. A specially designed bow gives well-cushioned riding qualities.

The Turbocraft is powered by a marine version of the Ford Zephyr Mk. 2 engine which is capable of developing 90 b.h.p. at 4,400 r.p.m. with a compression ratio of 7·8 to 1. As fitted, the maximum r.p.m. vary between 3,500 and 3,700 to give an output of about 70 b.h.p. and a long active life to the engine. The unit is completely water cooled, water being pumped direct from the marine jet unit through the sump to the manifold, circulated to the block, then to the exhaust pipe and out via the transom.

Propulsion is by a two-stage jet unit (Fig. 3). It draws water into the turbine through a steel grid fixed flush with the bottom of the boat and ejects it through the transom. The reaction from the jet stream propels the boat. The grid keeps out larger debris, but the jet unit will pass small particles of sand and gravel. The unit is quiet in operation and easy to maintain.

Full power is available on starting and the maximum progressive thrust gives the boat good acceleration. A hand-operated lever system moves a gate by which the jet stream is either fully cleared (ahead), completely blanked (neutral) or deflected forward under the hull (reverse). This does away with the reversing gear normally driven by the engine. The marine jet supplies cooling water to the engine. By manipulating an on-and-off cock, it can also be used to pump out the bilges.

One great advantage of this form of propulsion is the elimination of conventional underwater gear. The boat has no exposed propeller, shaft, strut, rudder or scoops to imperil the safety of bathers and water skiers or to foul fishing lines and ropes. It is claimed to give remarkable manoeuvrability and a performance most exciting to the boating world.

Steering is by a dished two-spoke steering wheel. On the steering column there is a sprocket over which passes a chain connected to a galvanised steel wire rope. This is connected through a pulley system to the marine jet steering column which connects to two steering vanes that deflect the jet stream. The pulleys used on the fore-and-aft inner hull are fitted with ball race inserts to give easy movement.

The fuel tank is mounted in the rear of the boat and is fitted with a sediment sump and drain-off cock. The fuel is taken from the top of the tank and a shut-off cock is fitted to enable the sediment bowl filter—fitted between the tank and the petrol pump—to be removed. Down-draught carburation is used and an air filter is fitted to act as a flame trap to reduce the risk of fire. All piping is of solid drawn copper tube with flared joints.

Standard equipment on the forward deck is a handle, two fairleads, one cleat, and a navigation lamp complete with pennant mast. On the stern deck are two cleats, two air vents, a ski hook, petrol filler cap, and stern light complete with ensign mast. Four small cleats, two port and two starboard, are provided for fendoffs, in addition to the fendoff strip around the gunwhale. There are four step-on pads, two either side. Two nylon mooring lines are provided.

A metal framed wrap round windscreen is fitted around the forward cockpit. The comprehensive dash panel includes an r.p.m. indicator with hour meter, ignition and oil warning lights, water temperature gauge, petrol gauge, ignition-starter key switch, choke and light switch. This switch allows for the fitting of a searchlight. Provision is also made for a speedometer as an optional extra. There are foot and hand throttle controls. The wiring harness allows the fitting of a horn.

Loose washable seat cushions and squabs are provided to match the selected colour scheme. Flooring is of marine ply to BSS 1088 covered with non-slip Trakmark; the rear cockpit panel is also covered with this material.

The standard boat is being produced with an all white hull and deck with either black, red or blue trim. Coloured hulls, or decks (in black, red or blue) can be provided with matching trim.

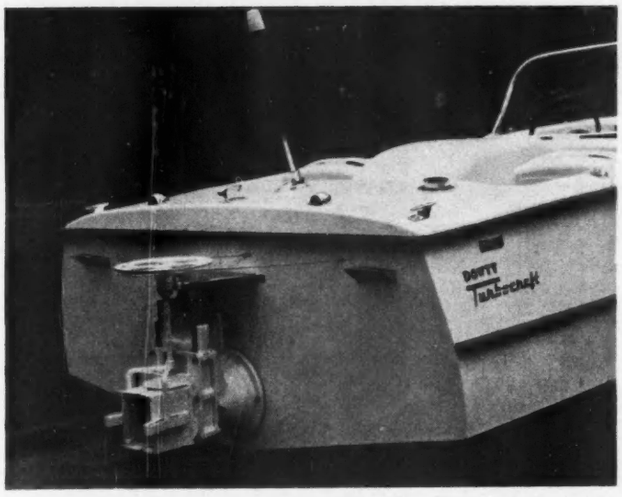
Overall specification of Dowty Turbocraft.—length, 14 ft 6 in; beam, 5 ft 9 in; draught, 9 in; power unit, Ford Zephyr Mk. 2; propulsion unit, Dowty-Hamilton marine jet (two stage); maximum speed, 35 m.p.h.; dry weight, 1,350 lb; fuel capacity, 10 gallons; and seating capacity, up to 5.

The design consultant for the hull was Mr. Fred Cooper, M.I.N.A., M.I.Mar.E., who also designed Miss England I and II, and Sir Malcolm Campbell's original Bluebird.

The boat was extensively tested by Donald Campbell, who found its performance and manoeuvrability to be excellent. In his opinion, there has long been a need for an alternative to the screw propeller, which is vulnerable to damage and a danger to swimmers, divers and water skiers.

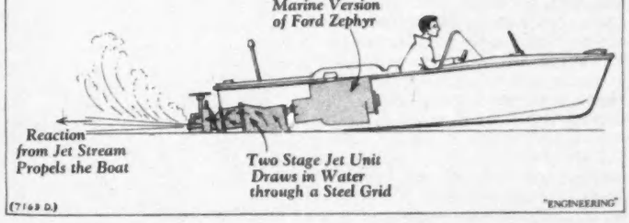
Fig. 2 The clean lines show up well in this tight turn.

Fig. 3 The propulsion unit before assembly in the boat.



(Left) Fig. 1 The cable and steering mechanism at the rear of the boat.

(Below) Fig. 4 Shows diagrammatically how the boat works. The reaction is under water.


Marine Version of Ford Zephyr
Reaction from Jet Stream Propels the Boat
Two Stage Jet Unit Draws in Water through a Steel Grid
(7169 D)
"ENGINEERING"

The Technical Problems of Broadcasting

Part 1—Sharing the Ether

By E. L. E. Pawley, O.B.E., M.Sc.(Eng.), M.I.E.E.
British Broadcasting Corporation

The problems of achieving and maintaining high quality broadcast reception on a national scale are more than meet the eye. One of the most fundamental difficulties is that of frequency distribution.

Since the range of frequencies suitable for radio communications is limited, though it has been extended from time to time by advances in technique, there is strong competition between the various services for shares in the spectrum. Broadcasting has a relatively small share, and its requirements are spread over different regions of the spectrum: long and medium waves being needed for sound broadcasting over fairly short distances; short waves (high frequencies) for world-wide services and for some shorter distance services; metric waves (very high frequencies) for television and for frequency-modulated sound broadcasting; decimetric waves (ultra-high frequencies) for television; and centimetric waves (super high frequencies) for point-to-point radio links. Table I is a list of VHF wave-bands at present allocated to broadcasting in the European area. In recent years there has been quite a considerable shift of interest from the long-wave and medium-wave bands to the VHF bands. This is partly because the wide channels required for television can be accommodated only in the VHF (or higher) bands and partly because interference in the long-wave and medium-wave bands has become so severe that the VHF bands offer the only possibility of a radical improvement in coverage and in the standard of reception.

TABLE I.—*VHF and UHF Wavebands in the European Area*

Band	Frequency range	Use	Remarks
Band I (VHF)	41-68 Mc/s	Television	5 channels for BBC Television service.
Band II (VHF)	87·5-100 Mc/s	Sound broadcasting	BBC VHF sound service at present mainly restricted to 88-95 Mc/s (about 40 channels already in use).
Band III (VHF)	174-216 Mc/s	Television	8 channels, of which some are at present allocated to ITA.
Band IV (UHF)	470-585 Mc/s	"	Not yet allocated in UK.
Band V (UHF)	610-960 Mc/s	"	

The BBC television service, at present restricted solely to Band I, provides an example of the problem of serving the whole country with a limited number of channels. There are five television channels in Band I, each occupied by a high-power station; these five stations work without serious risk of mutual interference. Each of these channels is shared with one or more medium-power stations, but they must be separated from the high-power station by a distance of about 200 miles. By adopting certain artifices, such as introducing small differences between the carrier frequencies and using directional transmitting aerials, it is possible to reduce this distance in certain cases. In this way, the coverage has been extended to over 98 per cent of the population by using 23 stations of various powers. Because of the sharing of channels and also because of international agreements designed to limit the risk of mutual interference with Continental stations, the power of each station is restricted. There is a second practical limitation on the range of each station: it does not extend far beyond the horizon; very high masts would therefore be needed for the transmitting aerials to achieve any significant increase in the range of the existing high-power stations.

For these reasons, the difficulty and cost of providing a service increases very rapidly as full coverage is approached. This is illustrated by Table II, which shows how the coverage has increased with the growth in the number of stations. It will be seen that in the latter stages of development it takes as many stations, but of lower power, to reach an additional 1 per cent of the population as were needed in the earlier stages to reach 80 per cent. This trend must apply also to other public services where the cost and difficulty of reaching sparse communities is high compared with that of serving densely populated areas; nevertheless television appears to be a particularly striking instance of it. A similar trend occurs with the coverage of sound broadcasting on VHF.

TABLE II.—*Population Coverage (BBC)*

At end of year	Number of stations	Total effective radiated power (kW)	Percentage of population	Number of licence-holders
1936	1	34	24	(no licence)
1946	1	34	24	7,467
1949	2	134	42	231,664
1951	3	234	65	1,162,359
1952	5	434	81	1,892,832
1953	9	436	86	2,956,846
1954	12	441	91	4,155,989
1955	14	476	94	5,400,083
1956	15	581	97	6,570,097
1957	18	682	97·8	7,760,794
1958	22	689	98·2	8,899,067
1959	23	698	98·6	9,844,365

INTERFERENCE DIFFICULTIES

There are two further factors that strongly influence this problem. First the coverage figures set down in Table II represent the total population within the areas where the average signal strength is sufficient to give satisfactory reception in the absence of interference from foreign stations. There are, however, some viewers within the nominal service areas who do not enjoy average conditions because they are screened from the transmitting station by hills or large buildings. This effect is partly counterbalanced by some viewers beyond the service area who are in particularly favourable localities.

The second point is that interference from foreign stations is at times severe towards the fringes of the service areas. There are several different methods by which this interference is propagated. Some idea of the characteristics of the three principal methods is given in Table III. It should be noted that ionospheric effects depend on the eleven-year sunspot cycle, the last maximum of which has just passed.

Apart from interference from foreign stations, one has also to reckon with interference produced by electrical apparatus, including both industrial equipment and domestic appliances. Such interference is naturally most severe in built-up areas. In this country, interference produced by small electric motors, by refrigerators and by the ignition system of motor vehicles is controlled by regulations issued by the Postmaster General under the Wireless Telegraphy Act, 1949. The tracking down of electrical interference to its source is the responsibility of the Post Office; during the last two years there has been a welcome reduction in the number of cases reported to them. This is no doubt partly due to the effects of the regulations, which have resulted in a much wider use of interference suppressors by manufacturers and users of electrical apparatus and of motor vehicles. It is also in part due to the fact that the effect of most forms of electrical interference is different on different wave-bands so that the increased use of Band II for the reception of sound broadcasting and of Band III for television has affected the incidence of complaints.

It is necessary to distinguish between appliances such as electric motors and thermostats, which generate interference only as a by-product of their normal use, and equipments used for industrial heating and for medical purposes which necessarily produce electromagnetic radiation at radio-frequencies as their normal function. In the former case the interference can be reduced by the use of filters, without affecting the performance of the equipment, whereas in the latter case the only means of preventing interference is either to use a frequency that is not likely to be troublesome, or to screen the whole equipment. Broadly speaking, the long-wave and medium-wave bands (especially the former) are the most susceptible to interference from domestic appliances, while Bands I, II and III are more susceptible to interference from radio-frequency equipment.

It is significant that all these forms of interference, with the exception of that produced by radio-frequency heating equipment (whether industrial or medical), affect Band I more severely than Band II or Band III, and Bands IV and V

TABLE III.—*Foreign Interference in Band I Television*

Sources of interference	Approximate height of reflection or refraction	Mechanism	Distance of source	Temporal variation	Channels most likely to be affected	Number of days in the year when interference may be observed in fringe areas of some BBC stations
Nearby Continental television stations, via troposphere	Up to about 2 miles	Variation in refractive index with height due to temperature inversions	200 to 500 miles	Worst in anti-cyclonic weather, which occurs most often in summer	All	30 to 70
Distant Continental stations, via sporadic E ionisation in ionosphere	70 miles	Reflection by clouds of ionised gas	500 to 1,300 miles	Usually worst in summer in the daytime and early evening	2 and 3	4 to 50
Remote communication services, including forward scatter stations via F layer in ionosphere	150 to 300 miles	Reflection by ionised layer	Several thousand miles	Usually worst in autumn and winter, near sunspot maximum, in afternoon and early evening	1 and 2	10 to 100 or more (at sunspot maximum)

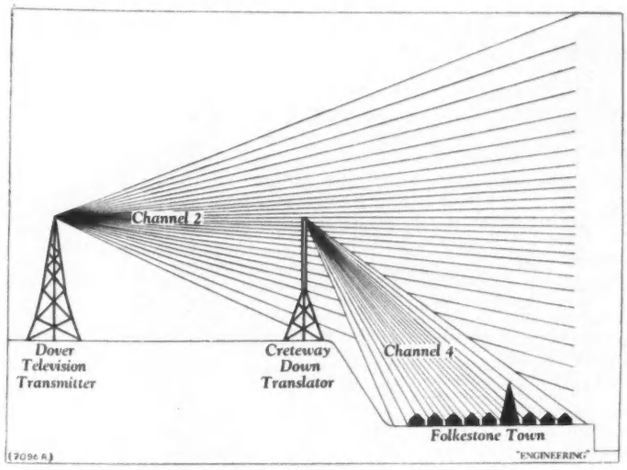


Fig. 1 (above) A translator is used to pick up the signal from the Dover transmitter (channel 2) and re-transmit it (channel 4) to Folkestone.

Fig. 2 (right) A map of the UK shows the coverage of the main stations and the channels used by them.

least of all. Interference from distant television stations is liable to occur in any of these bands, but the allocation of channels to these stations is decided in accordance with certain standards that have been accepted as giving a reasonable degree of protection from such interference.

In many cases the listener or viewer can reduce the effect of interference by using a directional aerial and a receiver suitable for the particular conditions of reception. The fact remains, however, that the BBC television service in Band I, and particularly the stations using channels 1 and 2, is vulnerable to occasional interference in the fringe areas. Viewers near the transmitting stations normally receive a signal of sufficient strength to over-ride the interference.

SATELLITE STATIONS

Coverage of BBC television in the United Kingdom has now reached 98·2 per cent of the population and the coverage of the VHF sound broadcasting stations extends to 96·4 per cent of the population. There is a pressing demand, particularly for television, in the remaining areas still unserved; but no channels are available for BBC television except in Band I which, for the reasons already stated, cannot accommodate any more high-power transmitters. The BBC has therefore turned its attention to the possibility of building a number of low-power transmitters to serve small areas and even individual towns. A number of such stations (14 for television and 10 for sound on VHF) are to be built in various parts of the United Kingdom over the next two or three years. The range of these stations will be limited partly by their low power, partly by the fact that some of them will be in mountainous country where communities living in the valleys may be screened by hills, and partly by the effect of interference from existing stations sharing channels.

The high-power television transmitters are installed in substantial buildings and require staff to operate them; moreover, they are fed by a network of lines and radio links rented from the Post Office at a substantial annual cost. For the low-power satellite stations now contemplated it was essential to develop equipment that could work unattended and could be fed directly from a main station without the use of lines or point-to-point radio links. Since many of the areas to be served are near the fringes of the service areas of the main stations, but screened from them by hills, it was evident that in such cases the best solution would be to receive the television signals from the main station at a point on one of these hills and relay them. Fig. 1 shows an example of this.

The local station must use a different channel from the main station to avoid interaction at the receiver between the direct signals and the relayed signals. This could be done by using a conventional receiver and a conventional transmitter, in conjunction with directional receiving and transmitting aerials; but a simpler and cheaper installation is possible by using a "translator" which the BBC has developed for this purpose. It is part receiver and part transmitter, and receives signals on one channel and transmits them on another without actually producing a video or audio signal at any intermediate stage as is done when a transmitter is fed from a receiver in the normal way. The circuits are considerably simpler and that part of the processing which is most likely to cause variation in the quality of the transmissions is eliminated. The translator is thus simpler, more stable, and more reliable than a conventional station and better for unattended operation.

Translators are used in large numbers in Germany, Italy and the United States. In the United Kingdom their design has to be somewhat more complicated because the amplitude-modulated sound used in this country necessitates greater precautions to avoid interaction between the television and sound signals than is necessary for the frequency-modulated sound used in most countries. The equipment is installed in a metal cabinet of the kind used for the control apparatus for traffic signals, and is designed to stand in the open air. In the case of the Folkestone station, the translator is set up on a high ridge overlooking the greater part of the town and also within sight of the television station at Dover; the signals are received from that station on channel 2 and re-transmitted on channel 4. The station is unattended and is provided with spare equipment which is brought into operation if the normal equipment fails.

This technique is best suited to hilly country where there is a concentration of population in an area screened from the main station. It can be used only where a site is available at which reliable reception of a main station or of another satellite can be secured. Even in the case of quite small stations of this kind the problem of finding channels on which they can work is difficult, because none of the other channels receivable in the same area can be used; indeed it is preferable that the transmitting channel should be at least two channels away from the one used for reception. The map, Fig. 12, shows the coverage of the main television stations and the channels used by them; it also shows approximately where the new satellite stations are to be built. It will be apparent that channels 4 and 5 were the only ones that could have been used at Folkestone and even these are subject to restrictions in power to protect Continental stations. Translators working on a similar principle will be used for relaying the three sound programmes on VHF; the same site may often be used for both television and VHF sound.

The higher frequency bands, Bands IV and V, are not yet in use for television in this country, though transmitters are already being built in Germany and Italy. There is a need to develop these bands because the potentialities of Band I have been virtually exhausted and Band III is insufficient to provide both for improvements in the coverage of the existing programmes and for additional programmes. The area range obtainable from a station in Band IV or V is considerably less than in Band I or III and the effect of obstacles such as large buildings is greater. On the other hand, Bands IV and V are almost immune to most kinds of interference. Moreover, existing receivers and aerials cannot be used in these bands, although it may be possible to use adaptors for existing receivers if the line standards adopted for Bands IV and V are the same as those used in Bands I and III.

Four more articles in this series will follow at short intervals.

On the Shelf

By Frank H. Smith

It is at this time of the year that librarians go stark staring with the prospect of preparing binding files. Apart from back numbers missing, which are sometimes due to their own lack of organisation and therefore placeable at nobody else's back door, there is the question of indexes and title pages. I do not know if there is any body on which all editors are represented (I doubt it in view of their wide range of interests—apart from editing) or if there is a Standard on the subject, but I and many others do wish some uniformity could be got into the whole business. Some journals issue the index and the TP with the last number, but not many. Some staple it in, some leave it loose. Some send it automatically to subscribers and some expect a request. Those that expect a request often put in such a small paragraph to the effect that it is ready that the librarian misses it altogether (and not all librarians scan their journals). And some have the overwhelming crust to charge for the thing. All this excludes such details as uniformity of layout, half-year and whole-year and other details that make for so much fun. The ideal, of course, is inclusion in the last number, stapled in.*

The last half of the 1959 batch has provided me with an argument for something for which I have agitated privately before. Some journals, admittedly very few, have a habit of putting on the outside cover the date of issue only. They do not put the volume and series number. As a result, my stooge (who makes up the binding) spent many hours chasing four missing numbers for the latter half of 1959 and it was not for some time that she remembered that there had been a strike, resulting in the loss of about four numbers. Another argument for serial numbers on the outside is the ease with which they can be checked—compared with adding seven to the previous date—particularly when you start on 31 days or 30 days—or even 29 in 1960.

I do not know what frazil ice is and my dictionary does not help. I am pretty certain it cannot be bought in the form of a family brick since it features as an article in *Engineering Journal* (Engineering Institute of Canada) of November—"Frazil Ice—a Review of Its Properties, with a Selected Bibliography." The bibliography is largely of Russian sources but there are, in addition, 55 references arising from the review.

I had to peer quite closely at the circular letter from Rank-Xerox Limited (33-41 Mortimer Street, London, W1) before deciding that it *was* a circular and not individually typed. They not only offer to copy my own stuff in the minimum of time but also they will microfilm *in situ* as it were and locate out-of-print works, clear copyright and then make a copy. Talk about feather-bedding (or is it wet nursing?).

If you are interested in Russian matrices (box springski) Interscience have published *Applications of the Theory of Matrices*, by Gantmacher, but if you drop them a line they will send you their catalogue of books on maths. The address is 88-90 Chancery Lane, London, WC2 (250 Fifth Avenue, New York 1).

From a recent issue of *Soviet News:* "The relief of the Atlantic ocean bed for a length of 9,000 miles from the English Channel to Dakar has been plotted by Soviet scientists . . ." This should be even more historic than that of Lucknow—and with no Scottish pipers to help them either.

* *Editor's Note:* Regrettably, an impossible ideal for a weekly journal, unless the standard of the index is lowered from a really worth-keeping production to a main-titles-only effort. We are not prepared to do that. ENGINEERING Index is free and automatic to any subscriber who asks us to include him on our Index mailing list.

Semiconducted Tour

Solid State Magnetic and Dielectric Devices. Edited by H. W. KATZ. *John Wiley, New York; Chapman and Hall, London.* (108*s*)

Solid state devices are finding ever increasing importance in engineering. A fairly large number of text-books and collected review articles exist, dealing with transistors and other electronic semiconductor devices. But there is a conspicuous gap in the available literature concerned with magnetic and dielectric solid state devices. This is, of course, due to the diversity of the field of research and applications of the materials and devices in this class.

The present book is hence very welcome, because it fills a real need. The next two important questions are: to whom is the book addressed? and how well does it, in fact, meet the intended purpose of conveying relevant and balanced information? Both these questions are difficult to answer because of the book's uneven quality. If addressed to either engineering students or those who wish to use magnetic and dielectric devices, then the book fails to give a critical assessment of the actual practical usefulness of the various subjects treated.

The properties of some solid state devices which are still in the early development stage are described in greater length and detail than some devices whose practical applicability has already been well established.

If the book is addressed mainly to students of physics and research workers in dielectric and magnetic devices, it can justly claim to bridge the gap between the fundamental knowledge of materials and the engineering applications of these materials in actual circuits.

The early introductory chapters on magnetic and dielectric properties are too superficial to be of any value for students to serve as an introduction or to be of help in understanding the complex behaviour of magnetic and dielectric devices treated later in the book. But those chapters introducing the systems or circuit function aspect of the devices are sound and their conclusions are, of course, used over and over again in the remainder of the book.

Almost two thirds of the text is concerned with actual devices such as electromechanical devices, microwave devices, magnetic and dielectric amplifiers and so on. Most of this is helpful and sound, and of interest to those who wish to use the devices, provided they have good prior knowledge of practical feasibility and technology of the devices, because the emphasis is on circuit functions.

There are a number of notable omissions, for example, magnetostrictive wire delay lines, and electromechanical filter elements based on magnetostriction resonators. On the whole, one feels that dielectric and ferroelectric devices are given undue prominence.

The chapter on digital techniques employing square-loop materials is of great interest, describing all the most recent developments perhaps a little too briefly. Magnetic recording is treated in some detail; unfortunately the complex physical requirements on material parameters are not at all stated. A final chapter on magnetic and dielectric measurements is again very patchy and of varying usefulness. One finds technical details of how to machine ceramics, but radio-frequency measurements on magnetic and dielectric materials are described only too briefly.

The maser is not included because it is stated that it does not fall within the scope of the present volume. One wonders why this should be so. Surely a solid state maser is a magnetic or dielectric device? Parametric devices are inadequately treated in an appendix, and are not stated to be outside the scope of the volume. Some of us may not quite agree with this arbitrary delineation of the subject and feel it is due to the particular interests and specialisation of the authors.

References are given at the end of each chapter but it is not always clear which part of the text refers to any given paper. Important papers from non-American sources are often omitted. There is a fairly adequate subject index. Like all American books, the present volume is very well printed and illustrated.

K. HOSELITZ

Advances in Semiconductor Science. Proceedings of the Third International Conference on Semiconductors held at the University of Rochester, USA, from 18-22 August, 1958. Edited by H. BROOKS. *Pergamon Press.* (100*s*)

If one was curious about the recent results, trends and ideas of pure semiconductor research, *Advances in Semiconductor Science* is the publication one would obviously consult. For it is the proceedings of the Third International Conference on Semiconductors, held at the University of Rochester, in the United States, and as such it contains theoretical and experimental papers and research notes, together with reviews and discussions, written by the leading people in the field.

These proceedings are of course, primarily meant for the research worker, a sort of vast memorandum from his colleagues; but this should not deter the student or the engineer, for in the review articles and especially in the excellent summary session he will find interesting comments on the status, trends and future of the science which demand no ultra-specialised knowledge to appreciate, and are certainly interesting in themselves.

Semiconductor science got a tremendous boost with the invention of the transistor, and as the germanium and silicon crystals became purer and purer so the study of them became more and more quantitative and exact until today we find that to progress we need very refined techniques indeed. Examples of advanced techniques are evident throughout the book, such as cyclotron resonance on the experimental side, and on the theoretical side the attempts to take into account correlations between particles, both concerned with band structure.

The most striking new technique is the electron nuclear double resonance (ENDOR) method of Dr. Feher (Bell Telephones) for investigating the structure of impurity levels, which he illustrates with measurements on the shallow donor levels in silicon. This method, I think, holds out hope for understanding the deep impurity levels which remain quantitatively obscure. The early interest in bulk and surface traps is reflected in several papers, and in this context the use of "hot," or fast, electrons is becoming increasingly important in the determination of capture cross-section.

Research into thermoelectric effects and thermal conduction is yielding interesting results. Nowadays, of course, refinement is spreading out to encompass the compound semiconductors and much work is reported on these. It seems, perhaps, odd at first sight to see a section devoted to ionic crystals, intrinsic insulators like the alkali and silver halides, in a book on semiconductors. There is, however, one link of particular interest, namely, the exciton—an electron and hole bound together by mutual attraction. Excitons form the subject matter of quite a number of papers and, indeed, one of the notable things which has come out of the conference is that, in the words of Professor Polder (Eindhoven, Netherlands), "Excitons have come to stay."

So much, brief though it is, for the topics to be found in this collection of 130 papers. What

of the future? Can any new revolutionary discoveries be expected? "In one sense, I believe the answer is no. Practically all of our basic ideas—energy bands, electrons and holes, phonons, excitons, polarons, dislocations, thermal generation and recombination of carriers, and so forth—date from the 'thirties or earlier. But the application of these ideas to particular situations . . . will continue to provide many interesting and important problems with unexpected results and new applications." So writes Professor Bardeen, the conference chairman and one of the inventors of the transistor, in the introductory paper.

One cannot help noticing, however, a major gap in the work reported in this book. Although semiconducting polar and covalent crystals are represented there is no mention of semiconducting molecular crystals, which should have interesting properties of their own. It is to be hoped that these materials will come into their own in future work.

The book itself is well turned out under the editorship of Harvey Brooks of Harvard University.

The papers assembled are well classified into groups, but there is a regrettably inadequate subject index. All told, however, it is obviously a book that no science library worth its grant can do without, representing as it does the vanguard of semiconductor research.

B. K. RIDLEY

Tractive Power Refinement

The Modern Diesel. By DONALD H. SMITH. Thirteenth edition. *Chilton Company, Book Division, Philadelphia, USA; Iliffe, London.* (17*s* 6*d*)

The thirteenth edition of *The Modern Diesel* comes from an author well known by those interested in small high-speed diesel engines, and particularly by members of the passenger and goods transport world. Mr. Donald Smith was for many years on the technical staffs of leading Iliffe publications and thus had exceptional access to the data incorporated in this book.

It is a difficult task to keep up to date in a subject where widespread and continuous development is taking place. This has been commendably achieved and results in a compact reference to over seventy engines from eleven countries.

The book will especially appeal to Ordinary National Certificate level students, operators and mechanics for its comfortable pace of introduction to diesel engines in general and more particularly to high-speed diesels for automotive use.

It is possible for anyone of moderate mechanical intelligence to read with interest and absorb the normally tedious chapters on the compression-ignition cycle, fuel injection systems, combustion chamber design and diesel fuel lubricants. These chapters alone give an excellent preparation for tackling more advanced books on those subjects, while the remaining chapters make good informative reading about modern applications. A bibliography is unfortunately omitted, but would be a valuable addition to any future editions as a guide to readers.

The introduction of the distributor fuel pump has particularly influenced the design of engines up to 250 horse-power. In this country the demand for distributor pumps for engines up to one litre per cylinder capacity has been so overwhelmingly predominant that relatively little attention to larger engines has so far been possible.

Development by individual manufacturers gives great promise and the continued use of these pumps on American engines up to 250 horse-power output, shows that they can be made robust enough for such applications. The distributor pump is invaluable when applied to V and horizontally-opposed cylinder engines where for high-output engines an in-line pump may be larger than the engine itself. Engines are now designed to take these units as distinct from untidy conversions from in-line pumps. Compared with the in-line units they offer reduced cost, weight, consistently good performance and easier maintenance, being simpler in construction. They can further be readily fitted with an automatic advance to obtain maximum fuel economy. Governing may be mechanical or hydraulic on distributor pumps. One British maker alone has already produced over 150,000 distributor pumps.

In future editions of this book, a whole chapter devoted to this development would be in keeping with its importance.

The table of engines of British manufacture reveals the preference for direct injection on all but the smallest engines. A notable omission demonstrating this trend is the Perkins Four 270D, the first to be offered by this company. There is a trend towards higher speeds, up to 2,500 r.p.m., on direct-injection engines and this combined with V or flat opposed cylinder construction and the more general use of dampers may lead designers away from air-cell types on smaller diesels. There is an active interest in V and horizontally-opposed engines with their more rigid construction and space advantages further stimulated by multi-fuel investigation, in other words, the use of a wide range of light to heavy fuel oils.

The table of British engine manufacturers should really include the Caterpillar and Cummins companies, because although these are basically of American origin, some departure has been made to suit British users and equipment. Cummins engines are being offered on British designed buses and trucks, especially for export markets. The latest Caterpillar and Cummins engines are higher-speed types (up to 2,100 r.p.m.) and are available in turbo-charged form giving very high power outputs.

Engine outputs of 200 to 300 horse-power are gradually being introduced into modern heavy transport and, with the advent of the motorways, will find a very definite place to maintain the continuous high speeds required. Such requirements were forecast by Clapp and Broadlove in "Commercial Vehicles and the New Motorways" (ENGINEERING, vol. 183, 1957, p. 206). AEC, Leyland, Rolls-Royce, and Cummins offer engines in this higher power range, while Albion, Daimler, Gardner, Meadows and Thorneycroft in addition offer engines of 150 plus horse-power.

In the chapter dealing with the diesel and private cars, the author is rightly not optimistic about the future. One aspect not mentioned is that of expected vehicle life. The expected life of a bus has risen from 10 to 15 years and some optimistic engineers hope for a life of 20 years.

While it is now quite true that one can see buses even older still giving good service, they should be regarded as exceptions. In the case of cars, many have an initial ownership of one or two years only. Car owners are thus not very interested in the long life of a diesel engine or an economy which only becomes real after several years.

The taxi and also to a large extent the small van, are fleet owners' vehicles and have the advantage of fleet maintenance. They likewise cover big annual mileages and obviously repay the increased capital cost much sooner than a private car would. Where car owners do cover big annual mileages, they must have the freedom from the noise and fuel smell that go with the diesel—especially in a small vehicle. Popular cars are tailored to competitive prices within five pounds and this margin offers no advantage to the diesel supplier. The complications of fuel tax, log book and fuel inspection maintenance are discouragements well indicated by Donald Smith in his compact, concise and informative book.

Although the lucrative field of the private car does not appear a likely future conquest of the diesel, the rest of the transport world on land and sea is certainly dominated by it.

LEONARD HARTSILVER

Astronomic and Atomic Time

La Mesure Précise du Temps. By B. DECAUX. *Masson et Cie, 120 Boulevard Saint Germain, Paris VIe, France.* (1,300 *F*)

As far back as we can go into the history of mankind, we find that the day, the lunar month and the year have served, in one way or another, because of their impressively regular recurrences, to denote and record the lapse of time. Thus the astronomer, with his observations of the motions of the heavenly bodies and especially those of the solar system, became the oracle of time. But during the past two decades or so the development and rapid establishment of new techniques in physics and radio-engineering, adaptable to the measurement of time-interval and the related quantity frequency, have given rise to such astonishing advances in the precise measurement of time that the physicist and the radio-engineer might well be tempted to set up an oracular rival, depending on the natural periodicities of atoms or molecules rather than on the motions of the heavenly bodies. However, as all concerned with these matters are fully aware of the complications and uncertainties that would arise from such action, much thought is being given to correlating and harmonising the scale of time furnished on the one hand by astronomy and on the other by the atom or molecule.

A clue has already been given to the basic principle of measuring the passage of time, namely to count and record the repetitions of some regularly recurring event by means of some kind of clock. Typical examples of periodic phenomena for use as clocks are:

(1) the rotation of the earth on its polar axis, the revolution of the moon about the earth and the revolution of the earth about the sun;

(2) the swing of a pendulum or of a balance wheel;

(3) the electro-mechanical oscillations of a quartz crystal; and

(4) the natural internal periodicities of atoms and molecules.

Any of these phenomena may be used to define a standard of time or of frequency, in other words the number of periodic events in unit time. There is need to distinguish between an instant of time (or an epoch) and a time-

Continued on next page

interval. To define an instant of time we establish a scale by selecting an arbitrary zero and maintaining a record of the number of cycles completed by the standard clock since the chosen zero of time; to measure a time-interval we observe the number of cycles of the standard clock which occur between the two epochs defining the beginning and end of the interval.

The primary requirements of a standard clock for defining the epochs of astronomical and historical events are continuity and regularity of operation. These basic needs are satisfied by the motions of the heavenly bodies as already mentioned. The smallest interval provided by the astronomical clock is the day, and this is subdivided into hours, minutes and seconds by pendulum clocks and chronometers. Quartz frequency standards, originally introduced to control frequencies in the practice of radio engineering, are increasingly assuming the function of the mechanical clocks for keeping time to very high precision. Although quartz clocks are highly stable, they are not sufficiently so for use as standards to define the unit of time. Their indications are adjusted in terms of the astronomical clocks and then used to smooth the errors of the astronomical observations and of interpolating between them. Recent developments in radio-frequency spectroscopy make it possible to relate these working-standard quartz clocks to periodic characteristics of atoms and molecules.

Two astronomical time standards are recognised: the rotation of the earth on its axis from which is derived the mean solar day; and the revolution of the earth about the sun which gives the tropical year. The latter is the means of defining the second of time for scientific, and particularly astronomical purposes, but the former, from which is derived the mean solar second, is more convenient for civil use and, indeed, for most scientific and industrial purposes. The second of time is the fraction 1/31 556 925·9747 of the tropical year for 1900 January 0 at 12^h ephemeris time. The designation for the datum point of the tropical year given in this definition is the astronomer's way of writing what is commonly understood as December 31, 1899, at Greenwich mean noon.

The relation between the two seconds can be obtained, but only retrospectively, because (*a*) the earth is found to be somewhat variable in its timekeeping and (*b*) the second defined by the tropical year can only be precisely established from astronomical observations extending over long intervals of time. Despite these difficulties, the mean solar second obtained through the intermediary of the time signals broadcast by the national time services (such as that provided by the Royal Greenwich Observatory through Rugby) is maintained uniform over a period of one year to about 5 parts in 1,000 millions. The time scale provided by the national time services is designated Universal Time (UT), which replaced Greenwich Mean Time some 30 years ago. The refined version nowadays emitted by the major observatories is designated UT2, in which the time signals, as broadcast, are corrected for predictable cyclic displacements of the earth's polar axis and variations of terrestrial rotation. Further corrections are later issued for errors derived from subsequent astronomical observations. Standard frequency emission services are also maintained by some countries. In the UK such a service, with the call-sign MSF, is operated by the GPO on behalf of the NPL and provides frequencies calibrated in terms of the NPL caesium standard.

The time signals broadcast by the national time services are used to calibrate a group of quartz clocks (in this country of the Essen-ring type with a frequency of 100 kc/s) treated collectively as a frequency standard which has a day-today stability of 1 part in 10,000 millions, corresponding to 10 μs per day. In the UK the mean frequency of this group of clocks is periodically calibrated in terms of the NPL caesium atomic frequency standard, which has a reproducibility of 1 part in 10,000 millions, equivalent to 1 second in 3 centuries. In other countries either the caesium atomic or the ammonia molecular frequency standard is being used for the same purpose.

The author of the present book, who is Ingénieur-en-Chef du Laboratoire National de Radio-électricité, Bagneaux, describes for the general reader how the precision of time measurement is improving so markedly, giving a reasonable account of the advances summarised above as well as those in the astronomical measurement of time. In effect, these topics are mainly covered in the last two chapters, comprising rather less than half the overall content. The earlier three chapters, rather discursively written, include a quasi-philosophical dissertation on the meaning of time with sections on relativity and time; the measurement of velocity (of light in particular) and distances (by the geodimeter and the tellurometer); the definition of the unit of time; time scales with their graphical representation; the emerging needs for high precision in the measurement of time; and some indications of the way the "optical pumping" and "maser" techniques are being developed for application in this field. Among the applications mentioned in which time-interval and frequency measurements are already required to an accuracy of 1 part in 100 to 1,000 millions are television and radio broadcasting, long-distance telephony, navigation systems, radar and geodetic surveys by "trilateration" methods. A more recent value for the caesium resonance frequency in terms of the (ephemeris) second than that given by the author is now available from the collaborative work of the US Naval Observatory and the NPL, namely, $f =$ (9 192 631 770 $\pm$ 20) c/s, the variation representing the present uncertainty in the knowledge of the second.

This book provides the general scientific reader with his first opportunity to review, within a single volume, the advances recently made in the accurate measurement of time. That is, provided he is persistent enough to wade through the preliminary chapters which, though interesting in themselves, are mostly too discursive even for inclusion under the book's title with its sub-title *En fonction des exigences nouvelles de la science.*

H. BARRELL

The Reviewers

Dr. Kurt Hoselitz is head of the Solid State Physics Division at the Mullard Research Laboratories. He holds a Ph.D. in physics and is a fellow of the Institute of Physics and a fellow of the Institute of Metals.

Dr. Brian Kidd Ridley is engaged at the Mullard Research Laboratories in theoretical and experimental work on recombination, transport and diffusion phenomena in germanium and silicon. He was previously at the University of Durham, where he presented a thesis on colour centres in alkali halides. He is a B.Sc., a Ph.D. and an A.Inst.P.

Mr. Leonard Hartsilver is assistant chief engineer of the Daimler Company Limited, Coventry, and during a long association with that company has been principally engaged in the design and development of heavy products. These include bus chassis, diesel engines, transmissions and earth-moving tractors, the latter to Ministry requirements. He is an M.I.Mech.E.

Dr. H. Barrell is superintendent in the Standards Division of the National Physical Laboratory. He is member for the United Kingdom on the International Committee of Weights and Measures, a body concerned with the maintenance and improvement of metric units and standards of measurement. He holds a D.Sc., a D.I.C., and is a fellow of the Institute of Physics.

New Books

Industrial Fuel Efficiency Diary for 1960. Edited by H. B. LOCKE. *H. O. Quinn Limited.* (Calf 13*s* 6*d*. Pigskin 11*s* 6*d*. Morocco Grain Leather 8*s* 6*d*)

So many diaries contain a miscellaneous collection of technical information, which may or may not be inter-related, that it is of interest to find one which has been planned as an entity. Within its limits of applicability to the work of an engineer dealing with the use of fuel, the technical section of this diary sets out to provide all the data needed in the user's day-to-day work. Over 100 pages of technical information, with an index for quick reference, and a set of nomographs which enable the user to dispense with the slide rule, are incorporated in the diary, which is small enough to be carried easily in the pocket.

General Galvanizing: A Manual of Good Housekeeping and Safety. *Hot Dip Galvanizers Association, 34 Berkeley Square, London, W1.* (25*s*)

Good housekeeping and safety go hand in hand in any industry. This manual shows that, in addition to the purely humanitarian aspect of the subject, improved conditions and safer practices can influence favourably the economics of production. Galvanising has its own special problem, but it also has many which are common to numerous other manufacturing and processing trades, and anyone connected with factory operation could read this manual with profit.

The Manufacture of Iron and Steel. Volume 2: Steel Production. By G. REGINALD BASHFORTH. 2nd Edition Revised. *Chapman and Hall.* (40*s*)

A revised edition of the book first published in 1951, this volume has been brought up to date by the inclusion of material dealing with new methods and processes of steel manufacture. In order to accommodate this new material, and keep the book within reasonable compass, all the information on fuels, furnaces, refractories and instruments has been withdrawn for inclusion in a separate volume, which is due for publication shortly. The present volume, though complementary to the author's volume I (Iron Production) is self-contained.

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Materials

Plastering. THE GOTHAM CO. LTD., Gotham, Nottingham. The "Green Book of Plastering" gives an outline of good practice with gypsum and gypsum premixed lightweight aggregate plasters. Written for practical men, in simple language, 90 page booklet. 1959 edition.

Marine Paints. JENSON AND NICHOLSON LTD., Carpenter's Road, Stratford, London, E15. 25 page illustrated book on marine paints and finishes is intended as a quick reference to all types of marine finishes and their application. Handbook.

Titanium—Wrought Products. IMPERIAL CHEMICAL INDUSTRIES LTD., Millbank, London, SW1. This is the first of five booklets which will constitute the most comprehensive and up-to-date information yet published on titanium by a British producer. Part 1, on wrought products, is illustrated and gives technical information on mechanical properties of pure and alloyed grades and the range of sizes and forms. Booklet.

Asbestos Sheets. UNIVERSAL ASBESTOS MANUFACTURING CO. LTD., Tolpits, Watford, Herts. The catalogues of this company have been designed around the classification system proposed by the International Building Classification Committee, and accepted recently for international use. This second batch of looseleaf sheets concerns their asbestos cement Fort sheets; the first was on their Standard Six range. Leaflets.

Nickel Alloy Steels. THE MOND NICKEL CO. LTD., Thames House, Millbank, London, SW1. This revised publication on the transformation characteristics of direct hardening nickel alloy steels incorporates supplementary information in the form of continuous-cooling transformation diagrams. They cover the range of cooling rates involved in the oil-quenching of 1 in to 6 in diameter bars. Booklet.

Marketing

Anglo-German-Dutch

A three nation tie-up is involved in the new sales arrangements in Holland for Hymatic Hydrovane mobile and portable compressors. The distributors for the Hymatic Engineering Company, of Redditch, Worcestershire, are to be Nellen Technische Handelmaatschappij, of Jan Evertsenplaats, Rotterdam.

The head of the Dutch firm was recently at Hymatic's factory for a week studying the construction, servicing and marketing of the compressors. The first sales scheme is for the Hydrovane mobile compressor 98 P100 which is driven by a Volkswagen engine.

Emphasis on Service

Extensive new servicing arrangements with world wide coverage have recently been announced by Matbro Limited, manufacturers of fork lift trucks and earthmoving equipment using the Fordson tractor as a power unit. Matbro have established a factory for service and spares supply at Horley in Surrey and have organised themselves to provide a service which, they say, " even the most exacting customer will find to be outstanding in this field." Maximum use is made of the Ford service " with its world wide system for supplying spares at low fixed prices." The 202 Fordson dealers in the UK will provide spares and service for the engines, axles, gearboxes, clutches, steering gear, etc., used in the fork lift trucks and earthmoving equipment, and in addition the company will have their own service vans operating from the factory.

Overseas customers will be able to obtain spares from Fordson dealers, but in addition the new stores will be able to air freight spares within half an hour or so of receiving a telephone call or cable, from Gatwick Airport which can be reached in 10 minutes. The factory also has its own railway siding for freight and is situated close to Horley main line station which has passenger train facilities.

America in Europe

The United States are undoubtedly growing concerned at the possible threat of exclusion of American products from European markets. The American Under Secretary of State, Mr. Dillon, ending last week his eight day tour of Europe, examined the whole question of European trade with particular reference to the creation of two rival blocs, the Common Market of the Six and the Free Trade Area of the Seven. Mr. Dillon evidently takes the view that such an economic division of Europe is potentially dangerous to American interests, both directly through a competitive raising of tariffs, and indirectly through a weakening of Western Europe's position in relation to that of the Eastern states and the Soviet Union.

Mr. Dillon is said to favour the reorganisation of OEEC with which the US Government might be very closely associated—perhaps as a full member—as a means of reuniting Western European countries and bringing about full cooperation between them. He anticipates a " face lifted " group to become a forum for negotiations between the Six, the Seven and the United States. In this way the difficulties upon which the Free Trade proposals floundered a year ago would have a better chance of being sold, particularly if the new sense of urgency in Washington over Europe's trade problems is maintained. There is little doubt that the United States will use their influence to the full to prevent the return to protectionist policies and yet to promote economic unity in Western Europe. Over the next few months, however, America's position is more likely to be that of an umpire in a highly discordant situation than a partner.

Coal Target

Unsold coal stocks may bother the Coal Board and the redundancy situation the miners' union but the coal industry still has its bright spots. One of them is the evident economic viability of the East Midlands division. Its production target for next year is 44 million tons and large scale recruitment of personnel has been resumed.

Medical Instruments for USA

An item of medical equipment which measures and records continuously the blood pressure through a finger cuff, had had a very good reception in the United States. The equipment, marketed under the name Winston-Green Blood Pressure Follower, is manufactured by Winston Electronics Limited, Shepperton, Middlesex, whose technical director, Mr. Roger Laurence, has been in the United States for some time. Enquiries for the equipment, which costs about £500 per unit (depending on recording requirements) are being received at the rate of more than 25 a day.

Another success story which has attracted considerable interest in America has been the award of a contract for water treatment equipment to the William Boby company, of Rickmansworth, Hertfordshire. Bobys are to provide demineralisation plants for the supply of cooling water for the stator of the 550 MW turbo-alternator which C. A. Parsons are to supply to the Tennessee Valley Authority.

Diesel-Electrics by Alco

A $13 million batch of orders in the United States for diesel-electric locomotives announced by Alco shows the vitality of the railways in North America, and in Mexico where some of the locomotives will be going.

Twenty-five of the units, low-profile 2,400 h.p. road switchers, are for the Atchison, Topeka and Santa Fe railroad and another ten of the same type for another US line. Sixteen 1,800 h.p. road switchers and eight 1,000 h.p. switchers were ordered for the Mexico National Railways.

Since the resumption of the production and shipment of steel there has been an improvement in the orders for railroad equipment and Alco's locomotive repair activities have also benefited.

Mr. W. S. Morris, president of Alco, has said that the locomotive orders just announced will be fulfilled by mid-1960. Earlier locomotives made by Alco for the Santa Fe line are now in service between Kansas and the West coast.

Davy-United Success

The placing by Richard Thomas and Baldwins of the order for their 68 in hot strip mill at Newport, Monmouthshire, with Davy and United Engineering means that Davy have secured both the orders available for such mills in Britain.

The Newport contract is worth around £4 million. With an initial output of a million tons of steel strip a year, and an eventual output of 3 million tons, the Spencer mill at Newport is due to begin operating in October, 1961. Davy will be working together on the project with their United States associates, United Engineering and Foundry, of Pittsburg, who will be building most of the cold rolling plant and the slabbing mill for the Spencer works.

The other 68 in hot strip mill recently ordered from Davy and United was by Colvilles for their new plant at Ravenscraig in Scotland.

Both new plants are very much to the forefront of current argument for the spread of the motor manufacturing industry either to South Wales or to industrial Scotland.

Marine Engine Orders

There may be little good news from shipbuilding quarters but Richardsons, Westgarth are able to announce the recent placing of marine engine orders with their group worth £2,500,000. Among them are the 22,000 shp geared turbine machinery for the new Shaw Savill liner which will be built by Vickers-Armstrongs. The Richardsons, Westgarth orders were brought in despite competition from overseas and home companies.

New John Brown Company

A new John Brown subsidiary has been set up solely to ease administrative problems. The business of John Brown's special engineering and nuclear division is to be transferred, fromtoday, to a wholly-owned subsidiary—John Brown (S.E.N.D.) Limited, which has been incorporated to carry on the activities of the division.

Pye at Suez

Whatever feelings may still rankle over the military operations in the Suez Canal area they have not been allowed to influence the choice of VHF radio equipment for the control of the Suez Canal Authority's vessels.

Pye Telecommunications Limited are to supply the equipment which will be used in the direction of dredges, tugboats and other craft at work on the canal.

Schrader in Europe

The movement of world-wide companies into subsidiary holdings that will enable them to overcome the trade discriminations of the European Economic Community (the Six) continue with the establishment of a new French firm, Schrader-Dubied, to manufacture tyre valves and air service accessories at Pontarlier.

The company is controlled by A. Schrader, a division of the Scovill Manufacturing company of the United States, who have set up the new firm with Edouard Dubied and Cie SA, of Neuchatel, Switzerland.

The plant at Pontarlier, which is almost at the physical centre of the European Economic Community, is intended to spread its services to the nations of the community.

Since starting up in 1844 the Schrader company has extended its interests to Brooklyn, Toronto, Birmingham and Cannock in Britain, Brazil, and Adelaide, Australia.

Business Machine Merger

The Massachusetts business equipment firm Farrington Manufacturing completed its absorption of other companies in 1959 by reaching out and buying Adrema, a British business system manufacturer.

Farrington's specialise in their optical scanner, a reading machine, and claim to be the leading world authorities on optical scanning. The Farrington optical scanner is widely used in the United States to feed information into computers and data processing systems.

Adrema, of which Lord Melchet is chairman, was selling in 55 countries, with two subsidiaries, one in Canada and the other in India. Lord Melchett, a banker and director of shipping and finance firms, remains as a director of Farrington and Mr. R. S. Cranston, managing director of Adrema, remains in that post and becomes a vice-president of Farrington.

The three earlier absorptions by Farrington in 1959 were the Intelligent Machines Research Corporation, the Printed Electronics Corporation, and Coated Fabrics division of Sawyer-Tower Incorporated, all United States firms.

" Freefone "

Despite its name, the " Freefone " service which began 12 months back in South Wales is now to be extended throughout Britain.

The primary purpose of the service is to help firms who want their customers and agents to telephone them without having to pay for each call.

The system works by the individual firm subscribing for a Freefone number and the person wishing to speak to the firm simply asks the operator, within the area which the firm has decided to pay for, for the company's Freefone number. The service applies to both trunk and local calls, the subscriber paying a fee, varying with the area covered from £5 to £50 a year, plus the cost of the call and a 3*d* transfer charge.

Telephonic progress goes ahead in Europe too. Following the connection of the automatic Dusseldorf exchange with the Dutch telephone system it is now possible for many West Germans to dial direct to numbers in Belgium, Luxembourg and Holland.

Cargo Handling Through Ship's Side

Modern passenger ships carry some cargo which must be shipped and unloaded quickly. It is also desirable that the cargo handling gear should not interfere with the passenger accommodation.

Passenger accommodation of an extremely high standard is being provided on the Peninsular and Oriental Steam Navigation Company's new 45,000 ton liner Canberra, now under construction by Harland and Wolff Limited, Belfast. The ship will carry various items of cargo, including passengers' baggage and motor cars, and if conventional cargo handling equipment were used, it would impose limitations on the design of the superstructure. Conventional equipment would require the provision of hatches trunked up through a considerable number of decks, or else the superstructure would have to be cut away to provide deck space for the hatches and handling equipment. Either method would involve a considerable loss of valuable passenger accommodation, and would also mar the appearance of the ship. The Canberra is therefore being equipped with cargo transporters, made by Carron Company, Falkirk, Stirlingshire, which operate through the ship's side and leave the superstructure entirely free of cargo handling machinery. In addition, the cargo transporter is very simple to use, requiring only one operator, the time taken to bring the transporter into operation on reaching port is negligible, and the risk of damage to such items as passengers' motor cars is greatly reduced.

There are two transporters, both identical. Each consists of a structural steel boom, carried on rollers within the ship, and capable of being power driven to project through doors in the ship's side. The boom is housed centrally within the ship when not in use, and can project on either side to suit the docking arrangements. On the boom, which extends some 30 ft from the side of the ship in the operating position, there is a travelling carriage from which is suspended a hoist with a cargo platform. An operator, seated in a cab on the carriage, controls the traversing, hoisting and lowering of the cargo platform.

To bring the cargo transporter into operation, the ship's doors are opened on the appropriate side, and the boom is traversed outwards to the limit of its travel. This is done from a push-button panel inside the ship, the propulsion being by means of an electric motor and winch hauling on wire cables. Electrical interlocking prevents the boom from moving if the ship's doors are not open and stops it at its limit of travel. Once the boom is extended, which takes less than 1½ min, and the power supply is connected to the carriage, the transporter is ready for use.

Power is taken by the carriage from overhead conductors mounted on the underside of the boom, in much the same way as on an overhead crane, but these conductors are not energised until a power cable is plugged in manually. Two plug points in the ship, one for boom operation on the port side, and the other for use on the starboard side, will be so positioned that the power supply can only be connected when the boom is out.

Mounted on the travelling carriage on the boom is a winch mechanism, from which hang four wire lifting ropes. These are led over pulleys on a car platform, and returned to a fixed point on the carriage, thus giving a double purchase. A cab is provided for the carriage operator in a position where he can see the platform at all times, and two crane-type controllers enable him to traverse the cab in either direction and to hoist or lower the platform as required. Limit switches prevent over-run of either the carriage traverse or hoisting gear in any direction.

To ship a motor car, the carriage is traversed to the end of the boom, the platform is lowered to the quay, and the car is driven on under its own power. The operator then raises the platform until it is just under the carriage, where it is automatically locked in position. Hoisting is at a speed of 60 ft per min. As soon as the platform is lifted, the operator traverses the carriage along the boom into the ship—the speed being 125 ft per min—and it comes to rest at the inner limit of travel. In this position it is above a hatch trunking leading to the lower decks where the car will be stowed; limit switches locate the carriage at this point.

As the platform is suspended on wire ropes, and has a total possible vertical travel of 45 ft inside the ship, it is necessary for it to be guided in the trunking. This is done by means of four rigid guides fixed to the sides of the trunking, and slippers on the platform which engage with them. Bell-mouthing of the slippers ensures initial engagement as the platform is lowered.

During the lowering of the platform and its load, the operator has full control over the motion by means of braking gear operated by the crane-type controllers in the cab. At the lowest of the three decks used for stowage, the platform comes to rest on the deck itself, but at the other two decks it must be located. When the transporter is installed in the ship, easily removable stops will be fitted to the guides to hold the platform while the car is removed. A limit switch operated light will warn the operator when the platform is close to the stops.

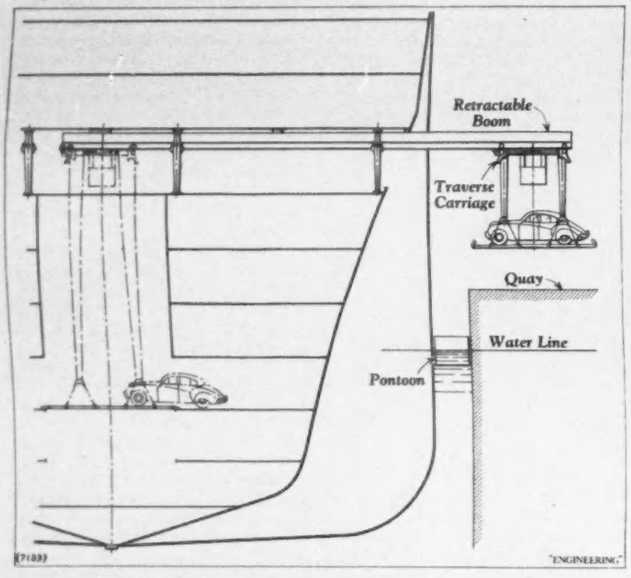
When the car platform is in use, the double purchase on the hoisting ropes gives it a lifting capacity of 3 tons. For handling cargo a different platform is used, and this, connected directly to the ropes with single purchase, has a lifting capacity of 30 cwt.

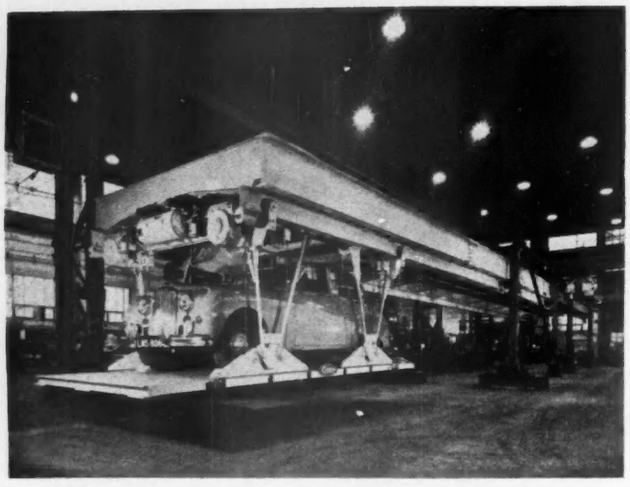
Quick change shackles and pins with safety locks are used to connect the hoisting ropes to the two platforms, and the changeover from one to the other can be made in a matter of minutes. The two transporters will handle all the cars and most of the cargo carried by the ship, but there is one forward hold, clear of the ship's superstructure, which will be served by an electric crane through a hatch in the normal way.

Passengers' baggage can be handled by the two transporters or by two special baggage transporters of 10 cwt capacity, of somewhat similar, but simpler, design, which are also being built by Carron Company. These transporters will be of the boom type, but push-button controlled from inside the ship, and the boom and carriage will travel simultaneously.

Carron Company have been responsible for the design and construction of the cargo transporter. Allen West and Company Limited, Brighton, supplied the control gear, the brakes are by Dewhurst and Partners, Hounslow, the boom was built by Sir William Arrol and Company Limited, Glasgow, and the motors were supplied by Bruce, Peebles and Company Limited, Edinburgh, and Associated Electrical Industries Limited, Rugby. Ronald Walker and Company, Glasgow, acted as consultants for the boom steelwork.

Diagrammatic layout of the Carron cargo transporter.





Shown during shop erection, the Carron cargo transporter is seen here with the boom extended. The first of the temporary supports on the right marks the approximate position of the ship's side.

Outlook 1960—Advance on all Fronts

This is the first of a series of articles assessing the factors influencing the engineering industries at the New Year. Forecast is made of likely trends—economic and technical.

The year 1960 could be something of a technical and economic break through. The high rate of technical change which has been gathering impetus since the war is coinciding with an economic build-up which started in 1958 with a gradual recovery leading to a boom in consumer goods and which has now generated a strong recovery in capital goods.

It is not likely that the consumer boom of 1959 will go very much higher this year. The rate of increase in expenditure by the public is likely to slacken off although there is likely to be some increase in the absolute level of consumer outlay. The driving force this year is likely to be the recovery in capital goods and this will, if other forces, especially external ones, do not intervene, lead to a further expansion in expenditure by the public in due course. If this should happen, it is already apparent in which direction outlay will tend to increase.

Emphasis on expenditure in the home is expected to develop into a pronounced trend through the 1960's. The Englishman may well spend an increasingly large proportion of his income on his own castle rather than on food and entertainment. Should this be the case, there will be increased national resources applied to the production, design and selling of consumer durable goods for the home. This means that there will be increased opportunities for the light engineering industries but that competition will be keen and the public is likely to be increasingly discriminating in the goods it buys.

Another pointer from 1959 is the increased political and economic importance of the development areas. The higher level of unemployment in 1958 compared with 1957 and earlier years emphasised the big variations in unemployment which can still develop in this country in different localities at different phases of the trade cycle. The old " special areas " are still heavily dependent on heavy engineering and the unemployment figures have shown that even now, 25 years after the establishment of the first trading estates in such areas, light industry is still only making a modest contribution to industrial stability.

The statistical picture was quickly reinforced by the General Election last October when areas with a high level of unemployment voted contrary to the national swing towards the Conservative Party. The result has already been a proposed reinforcement of the Government's statutory powers to help the so-called development areas and a revival of the Government's efforts to bring pressure to bear on sections of the engineering industry making durable consumer goods to move into development areas. Towards the end of the year the Government were making strong efforts to persuade either the Ford Motor company or the British Motor Corporation to set up a branch factory in Scotland.

SPEED OF CHANGE

Reference was made earlier to the rapid rate of technical change in industry at the present time. The economic conditions which obtain at the turn of the year make the pace of technical advance at this particular moment of time especially significant when it is related to the economic situation. The last big investment boom in capital goods occurred in 1955 and 1956. Since then many industries, including the engineering and metal forming groups, have been completing capital investment schemes which were put into operation in those years. The later stages of these schemes, however, coincided with a comparatively high level of unemployment and it has been significant that many industries have been able to raise their output and raise their productivity over 1957 and 1958 without taking on more labour or without having recourse to an increase in overtime. In other words, such industries were running significantly below capacity and yet were able to meet the market's requirements and register a rise in productivity.

As the machines and techniques installed between 1955 and 1958 become used more intensively by an increased labour force (which is already showing as a decline in the numbers of the unemployed) the scope for a further big increase in productivity is extended. In other words the conditions exist in 1960 both for a marked recovery in the capital goods industries and for a rapid rise in productivity. These in turn can lead on fairly quickly to a further advance in the standard of living and an increase in the purchasing power of the public. The two main hazards in the way of such a development are the possibility of renewed inflation and the onset of difficulties in expanding this country's external trade.

Exports were buoyant in 1959. For the first 11 months, the seasonally adjusted monthly average for exports was 4½ per cent above the figure for 1958 and imports showed a 6 per cent rise. The two notes of caution necessary on this performance are that a very high proportion of the increase last year was in motor cars and non-durable consumer goods to the United States and that towards the end of the year imports were rising more quickly than exports. Nevertheless, the export position, the modest increase in the import bill and the healthy state of the balance of payments towards the end of last year all indicated a sound external position which could support both a high level of prosperity at home and significant investment overseas.

PRIMARY COMEBACK

Are these conditions likely to apply right through 1960? So far as exports are concerned, the US market is likely to continue buoyant despite the protracted steel strike. In addition, such traditional markets as Australia and India are likely to maintain, if not improve upon, the level of imports they have taken in the last year or so. These markets will be increasingly competitive as other countries, notably Germany and Japan and possibly the United States (since it is becoming increasingly conscious that its high cost structure is pricing it out of world export markets) are likely to offer growing competition. Other primary producing countries may well stage something of a comeback as a market for exports this year.

Those dependent on the buoyancy of the price of their export crops and minerals will have a somewhat better year in 1960 than they had in 1959 which was in turn significantly better than 1958. Trade with the Middle East is likely to be at least as good as last year for the prospects of stable economic conditions are equal to last year and perhaps slightly better since diplomatic relations have been resumed between the UK and the United Arab Republic. The political stability of Iraq remains a question.

The big problem in the export field for 1960 is the future relationship between the European Economic Community (often referred to as the European Common Market or " The Six ") and the European Free Trade Association (often referred to as " The Seven "). So far as this country is concerned the establishment in Stockholm in November of the EFTA has brought with it the prospect of increasing trade in each direction with Scandinavia, to mention only the most important export area for this country covered by the Association. On the other hand the prospects of the EEC and the EFTA coming to some joint agreement about tariff disarmament have not improved.

The French remain hostile to any conciliatory move by the EEC in spite of West Germany's efforts to bring about a rapprochement. The United States let it be known in December that while it would not oppose either the EFTA or the EEC under the General Agreement for Trade and Tariffs it would view with disfavour any tendency for a union of EFTA and EEC to bring about a large Western Europe economic bloc which kept its tariffs high to the rest of the world including the US. It also indicated that if the EFTA and EEC really ran foul of each other, the United States Government would be obliged to support the claims of the EEC since it favours the federal political aspiration of EEC whereas it views the EFTA, and quite correctly, as no more than an economic association between sovereign states.

IMPORT COSTS

So far as this country's import bill is concerned this year, it is almost certain that the upward trend which developed late in 1959 will continue into 1960. Throughout 1959 manufacturers of stocks of raw and semi-finished materials were at a low level and industry lived on a hand-to-mouth basis. 1960 must see a certain amount of restocking and there will be not only an increase in the volume of imports but also in their price. If a high level of overseas investment is to be maintained it is therefore vital that exports remain buoyant and that restocking by industry should be continent. Whether exports can be kept buoyant within the next few years depends very much on the level of costs in British industry.

The unions are likely to bring greater pressure to bear this year than last for better working conditions in the form of reduced working hours. There will also be demands—some are bound to be successful—for higher wages. Unemployment in the engineering and metal forming industries dropped from about 100,000 to 90,000 in the first half of 1959 and the figures have probably improved further since. So far as reduced working hours are concerned, it is likely that the unions will have some success, not least in the engineering industries.

The progression towards the 40 hour week has in fact become an organised, strategic exercise for the trade union movement in which the engineering unions are playing an important part. On the whole, the reduction in working hours likely to be won by the unions this year will probably be offset by increased productivity. Lower working hours are likely to clip off something like 2 hours per week in the typical industry and this is a burden of about 5 per cent on wage costs and therefore of 3 or 4 per cent on total costs. The percentage will be higher, and correspondingly dangerous, if a fall in standard working hours adds a proportion to overtime working. If shorter working hours are accompanied however by higher wages there will certainly be pressure on industries costs and the beginnings of a new inflationary build-up.

SUMMARY

The outlook may be summed up like this. The year 1960 could be a key moment in the industrial revolution of the late 20th century—as critical as was 1760 in the 18th century when the first industrial revolution was touched off. The United Kingdom is well placed to take advantage of it. Employment is full but not overfull: there is a modest but useful amount of modern, un-used capacity in some industries which have recently completed development programmes: stocks of raw materials and semi-finished goods are low: the demand for fuel, power and steel is rising and, at long last, so is private industry's demand for machinery.

Engineering industries, except perhaps for shipbuilding and the like, are going to have it good.

Motor Vehicles

The motor industry is in a mood of confidence. All major groups have large expansion plans behind them and with production now rising to fill the increased capacity are preparing for further, and in some cases even larger, development.

Output of passenger cars, which rose to 1,051,000 in 1958, has increased to an estimated 1,150,000 in 1959, while that of commercial vehicles rose from 312,852 to an estimated 357,770. On the showing of the first nine months, exports of cars will have risen to 523,000 cars and 56,600 commercial vehicles, compared with 451,261 and 57,326 for 1958.

The two factors leading to this happy state of affairs are the buoyant home market, and the further rise in exports to the United States and Canada. Sir Leonard Lord reported in November that the British Motor Corporation had experienced a home demand which consistently outpaced supply, due to the combined effects of new models, general prosperity and purchase tax concessions. The rather undramatic increase in total production for the year (most of which was accounted for by exports) must be attributed partly to the changeover to new models, partly due to running down of stocks (60,000 in the first eight months) and, to some extent, to labour troubles. So far as home sales are concerned the market seems likely over the next year at least to absorb a further increase of output.

Exports

The pattern of export markets has been steadily and significantly changing over the past two or three years. As markets for direct exports, countries which were formerly the most important have shown a marked decline. Exports of cars to the Union of South Africa in the first three quarters of 1959 amounted to 17,854 units, compared with 36,356 for the same period of 1958. Corresponding figures for Australia were 12,168 and 19,988; for New Zealand 13,946 and 17,571. Overall, car exports to the Commonwealth, excluding Canada, fell from 204,228 to 177,497 for the same periods.

Exports to foreign countries, including Eire, but excluding the United States, rose from 92,872 to 97,642, including an increase from 21,070 to 23,845 in sales to the Common Market countries.

In contrast, exports in the first three quarters to Canada rose from 32,731 to 52,573 and to the United States from 109,045 to 162,381.

The broad picture is thus of a steady decline in the whole Commonwealth except Canada, a dramatic increase in the United States and Canada, and a slight increase in other foreign countries. These trends have so far resulted in a good increase in total exports; how far are they likely to continue?

So far as the major Commonwealth markets are concerned, excluding Canada, local production must be expected to continue to increase with a corresponding decline in direct exports. An increasing number of components are being manufactured locally in the Union of South Africa, with the eventual intention, following Australia, of producing complete vehicles. This trend can hardly be reversed, and British manufacturers can retain their footholds in these markets by increased output of their own products in these countries.

The chief question in the American market is how far the new "compact" cars of General Motors, Ford and Chrysler will attract the market so well cultivated by imported European cars. These new vehicles are certainly not small cars by European standards. Full six-seaters, with 80 to 100 b.h.p. engines, they would on the British market be termed large. With selling prices upwards of $2,000 they are considerably more expensive than most imported cars—and not very much below the price of the standard domestic product. However, during the past year, some 18 per cent of the American market has been captured by imports and the existing American "compact" cars—pioneered by the American Motors "Rambler"—and the Big Three are reported as confident of selling 800,000 in 1960. They are also confident of reducing the number of imports by as many as 100,000 vehicles.

The fact remains that, so far, sales of American "compact" cars have largely been at the expense of the larger cars. It may well be doubted whether the new models are sufficiently different from standard to attract buyers, part at least of whose motives in the past two or three years must have been the "distinction" of owning a European car. There may be a slight parallel here with the earlier success achieved by British bicycles. It should also perhaps be borne in mind how suddenly that market collapsed through a change in public taste.

Manpower

In a year of rising production and good prospects there have been a regrettable number of stoppages in the industry. These have been so many and so widespread, that little useful can be said of them in a survey of this kind. Among the difficulties which are continuing to lead to strikes are the disparity between time and piece rates, and rivalry and overlapping between the many unions involved. The former problem is always liable to come to a head at any time of rising prosperity. Here, as in shipbuilding, much could probably be learned from a comparative study of labour relations in different companies—if all the parties could agree on such a study being made.

The motor industry differs from shipbuilding in the speed with which a minor dislocation can affect a rapidly widening circle of workers not directly involved in the dispute. The series of comparatively brief stoppages is therefore particularly damaging.

The location of new plants is discussed below. While from many points of view it might be preferable for companies to expand where they are, this would almost certainly lead to severe labour shortages—which would be no less serious because they would probably be transferred to the shoulders of other industries.

Plant and Products

Whatever the market prospects, there is little doubt of the confidence of the major motor manufacturers. Expansion of production has now more than recovered from the setbacks of the credit-squeeze and the post-Suez recession, so much so that production figures are now confidently expected to reach previously estimated levels at least twelve months ahead of schedule. By the end of 1959, production of cars was running at an annual rate of between 1·3 million and 1·4 million. Estimates for 1960 have been put at a rate of between 1·6 and 1·75 million to be achieved by the end of the year. In addition to this, annual rate of some 450,000 commercial vehicles is expected with some confidence.

The heavy investment which the industry has made in recent years has thus justified itself (output of cars has very nearly doubled since 1954) and heavy new commitments are now being considered or taken on. The total of requests for planning permission for new developments which are now before the Government is reported to be in the region of £150 million. The structure of the industry means of course, that this is concentrated into the plans of very few companies—two-thirds of it the British Motor Corporation and Ford. In 1958, over 90 per cent of total British motor vehicle output came from the Big Five, the shares being estimated as follows: British Motor Corporation, 34 per cent; Ford, 28 per cent; Vauxhall, 11 per cent; Standard, 10 per cent; and Rootes, 9 per cent. In other words over 60 per cent came from BMC and Ford alone.

BMC has spent some £39 million on production facilities over the past five years, and output at the end of 1959 was running at 750,000 units a year. In his annual review in December, the chairman, Sir Leonard Lord, said that he expected the Corporation's total vehicle production to reach the "magical" figure of 1 million units a year within the next two years.

An immediate point of attack is in the production of "mini-cars." £10 million were invested in facilities for producing the Austin Seven and the Morris Mini-Minor, which were completed and at work by mid-1959, to provide a maximum output of 4,000 units a week. Steps are already in hand to double this output to 8,000 vehicles a week, and to include a range of light commercial vehicles to be announced in January. The British answer to the bubble car has arrived late in the day (discounting some more or less still-born projects) but well this side of never.

Details of Ford's expansion plans have not yet been made public, beyond the fact that over the next few years the planned expenditure lies between £45 million and £50 million. This follows on the previous £75 million expansion plan which has been completed during the past year.

Vauxhall are reported to be engaged on detailed planning to increase their present capacity from 250,000 to 300,000 vehicles a year, by installing additional plant in existing buildings. The £36 million expansion programme, planned some five years ago, has now been completed. Standard—now known as Standard-Triumph International—has been profoundly occupied in readjusting its position after the divorce from Massey-Ferguson the agreement with whom was terminated at the end of August. This left Standard with the problem of expanding its car production to nearly double what it had been hitherto, since it had been agreed that Standard would not sell tractors until 1st May, 1961. Tractors were previously accounting for some 75,000 out of a total of nearly 160,000 units a year. The measure of success achieved in making good the loss of tractor production can be gauged by the fact that by the end of November car production was running at a rate of about 150,000 a year. It was hoped that by the end of 1959 the rate should have reached that previously achieved for combined car and tractor output. Further expansion would not be possible before the Spring of 1960, due to lack of facilities, but the aim beyond that time is to increase progressively up to a rate of 180,000 a year.

Out of the satisfactory cash balance left to Standard after disengaging from Massey-Ferguson (some £17 million including sales of tractor stocks) the company are already committed to capital expenditure of £6 million, and have some £4 million in hand for further capital projects. Standard have over the past three years been unable to expand car sales largely because of the difficulty of obtaining painted and trimmed car bodies. With the installation of the company's new body paint and trim plant at Canley, the purchase of the Coventry factory of Fisher and Ludlow and the acquisition of Mulliners, the difficulty has largely been removed.

The Rootes Group suffered setback in the fire in September, which did about £3½ million of damage. Much of the loss was expected to be covered by insurance, but production inevitably suffered. The Group announced in October that it would undertake an expansion programme costing about £10 million roughly over the next year. The majority of this was to be spent on production and the remainder on extending distribution facilities. The company stated at the same time that it would not attempt to enter the mini-car field.

The major groups appear to be showing an increasing interest in acquiring manufacturing facilities on the Continent. For example,

Standard-Triumph have bought a site for a factory in Belgium, scheduled for an initial rate of assembly of between 2,000 and 3,000 vehicles a year. In December, the possibility was reported that Rootes might take a strong interest in the German BMW.

The assembly of British cars in Commonwealth countries must inevitably expand—a trend which will reduce direct exports to those countries.

The fresh expansion which is to be expected in the motor industry has led to renewed pressure from areas of high unemployment, for the siting of new plants in these areas—rather than in the established centres of the Midlands, Luton and Dagenham. Echoes of the controversy over the fourth strip mill have thus been raised. The possible areas concerned are of course Scotland, Merseyside and South Wales. In favour of Scotland, it has been argued that new plants could draw their sheet supplies from the Ravenscraig strip mill when this comes into operation in 1963; an incidental argument is that this would also help the strip mill, though there is little doubt that this has been planned with a view to nationwide and not purely Scottish distribution. In any case, none of the three possibilities are far from sources of sheet—for example, the Newport strip mill of Richard Thomas and Baldwins (expected to be producing some steel at least by the end of 1962) and the John Summers mill at Shotton.

From the social point of view, a decentralisation would obviously be desirable. Pressure for both space and labour in the Midlands can easily become acute; unemployment in the Birmingham area is less than 1 per cent and there are more vacancies than men to fill them. For any area with a high rate of unemployment—broadly speaking, those which are dependent on heavy engineering, coal and shipbuilding—the acquisition of a part of the thriving motor industry would be of enormous benefit. Further expansion in the existing areas would mean either importing labour from the pockets of unemployment, thus furthering the decline of those areas; or competing for labour as has happened before —a struggle which the motor industry is almost bound to win, to the detriment of other industries such as machine tools and public transport.

From the industry's side, possibly the two main drawbacks are those inevitably associated with decentralisation, and accessibility both to home markets and to ports for export. The difficulties that can arise when components are manufactured in too widely dispersed factories have been stressed many times, and transport costs are of course increased. In 1958, the most important home markets lay in the Lancashire-Yorkshire industrial areas, followed by South East England, the Midlands, South Wales and the Scottish industrial belt. This of course says little, since the presence of a strong section of the motor industry in any of the lesser market areas could act as a general catalyst for expansion.

Lading ports for exports are at present London, followed by the Mersey, and a very poor third, the Severn. This again, to a fair extent, merely reflects the present location of the motor industry.

Thus though the companies would almost certainly prefer to expand at the existing sites, and have good economic reasons for doing so, it is more than likely that at least a large part of any future expansion will take place elsewhere in spite of strong denials. Though the government has, of course, no final power to determine the location, it has the power to refuse applications for large scale development—and the Board of Trade has already indicated its intention to refuse to grant industrial development certificates for more than 5,000 sq. ft of factory space in either London or Birmingham. And in massive lobbying, the Scots seem to be winning hands down.

Materials

The prolonged American steel strike, combined with delays in UK deliveries of sheet steel, led during the latter part of 1959 to some anxiety. The shortage arose partly from the rapid growth of car production, and partly from the fact that extra capacity at the Steel Company of Wales did not come into operation on schedule. The American strike operated in two ways. In the first place, the increased competition from America for European exported steel made extra supplies from this source virtually unobtainable. Secondly, the company hardest hit, Vauxhall, obtains a considerable part of its supplies from America.

Apart from Vauxhall, who were compelled for a time to stop Saturday working, the shortage appears to have been made good. Imports had been maintained in the early part of the year as a precaution, but by July were averaging nearly double the rate experienced a year previously.

Research

Radical changes in automobile engineering are few and far between but, in December of last year, one of the most significant developments since the beginnings of internal combustion was announced—the NSU-Wankel engine. As a means of obtaining propulsive power it is so new as to be called an invention rather than a development. It is not yet ready to work with full effectiveness in a motor car, much research and development has to be done before it will have the necessary characteristics for motor vehicle propulsion, but the principle has been well demonstrated. Both NSU's in Germany and Curtiss-Wright's in America are exptected to be producing rotary ic engines in some form or other by the end of this year.

Even more advanced is the gas turbine engine for motor cars. Little has been heard from the Rover Car Company since they gave their first exciting demonstrations with a gas-turbine car some years ago, but there has certainly been no indication that they have abandoned their programme. In addition to the Rover Company's advanced work in this field there has been news of similarly striking developments from the Ford Motor Company in the USA. So it is not unreasonable to suppose that we are getting near to the day when the gas-turbine motor vehicle will become a practical reality instead of a dream.

The aerodynamics of motor cars have been the subject of increased attention in the past year or two, in fact so much has the importance increased that the Motor Vehicles Research Association have decided to build a wind tunnel to conduct experiments with full-size cars. The main reason for the increased concern over aerodynamics is that cars, even family cars, are now able to travel at extremely high speeds, so that wind effects have become a design feature in their own right. For instance a body designed to give lower wind resistance may, at high speeds, not have enough air flow to cool the brakes. This is because the two factors involved—air drag and circulation around the wheels—are diametrically opposed to one another.

A most welcome development for all motorists occurred last year when Pirelli Limited introduced their technique for replacing the tread of worn-out tyres. Demonstrations given by Pirelli have more than adequately shown the idea to be practical and production is expected to begin in Britain soon. In the light of this it seems highly likely that the majority of motorists will soon be using the Pirelli (or similar) technique, so that in future the cost of " usable " rubber will be a lot more reasonable than it has been in the past.

The unchanging pattern of thought on the construction of car bodies has at last been broken. The welded pressed steel body has now been upset in its position of supremacy by the new Triumph Herald chassis/unit section technique. This particular form of construction gives the car a good rigid basis on which a variety of bodies could be placed. Because the body is not the main structural feature, engineers are able to use relatively small parts be bolted to the chassis and to each other. This lowers tooling costs by enabling the load to be spread over a wider field of industry than if the entire body had to be made by one firm. It also means that the sections can easily be removed and replaced if they become damaged.

Design

Body styling has been by far the most noticeable design feature of automobiles in the past year or so. Moreover, there has been a strong, world-wide tendency towards Italian designs. These two matters are related.

The body-stylists of Turin have in recent times established a unique prototype development technique, whereby they are able to design and produce a prototype body in an incomparably short time. This could not be done by motor manufacturers, who may often take as long as nine months to construct a model. So it is as much by their speed as by their skill that these Italian design teams are able to dominate in this field, and it is because of their speed that manufacturers are more readily inclined to have new designs for their cars.

Giovanni Michelotti, stylist of the much admired Triumph Herald and one of the better known Turin designers, works in conjunction with the coachbuilder Vignale. When commissioned to design a body, Michelotti first sends his proposals in the form of a few perspective sketches to the manufacturers. When one of these has been selected it is followed up by a detailed side elevation and then, a little later, by lifesize projection drawings. These latter drawings, which are considered to have some artistic merit, are done on a paper which takes up the whole wall of his studio; and they take only two days to complete.

A sculptured wooden model is then made, in three to four weeks, and passed to the Vignales factory where it is used as a basis for the construction of an intricate " birdcage " jig. About six weeks from the date of receiving this wooden model the final body shell is either welded or bolted into one piece and is ready for painting, glazing and upholstering. So that, in only three months from the drawing of the first sketch, the chief designer is able to sit in and judge a fully detailed prototype model of his design project.

This rare combination of speed and artistry has put the designers of Italy on a firm footing in the business of body design and there is no reason to suppose that they will not consolidate their position still further in the coming year. As a race the Italians are second to none in combining art with engineering craft, but their biggest asset at the moment is something quite different—speed.

Looking at a different form of speed—the speed of the car itself—we see yet another developing design trend. Speeds of the order of 80 m.p.h. used to be for the sports car owner only but now the majority of family cars are more or less in this class. In fact many of today's sports cars have engines that are basically those of family saloons, but with higher compression ratios, extra carburettors and other such modifications. Even pure economy cars such as the BMC Baby, with its top speed of about 75 m.p.h., are reaching the high speed class.

The ability of the baby car to compete in performance with the full size family car is an indication of a trend which, if it develops much further, may change the whole complexion of the car market. If economy car designers can succeed in combining the outstanding qualities (and low price) of cars like the Austin Seven and the Ford Anglia then interest in the family saloon is going to ebb very considerably. That is unless the standard of living rises to such an extent that the cost of a car takes second place to the importance of keeping up " with the Jones's."

Agricultural Machinery

Agricultural machinery producers as a whole continued to increase their output in 1959 and in most fields the upward impetus was more marked than in 1958, at any rate during the earlier months of the year. While there were declines in the rate of production of some items of equipment such as mould board ploughs, farmyard manure spreaders and combine harvesters, the output of tractors, particularly market garden types and of mowers and pick-up balers increased very considerably.

In the first six months of 1959 the total value of output was running at an annual rate of over £180 million compared with £142·5 million in 1958. Although output of some types of agricultural machinery is seasonal, the variations tend to cancel out the total production in the first six months of 1958, at £76 million was only slightly higher than the rate for the year as a whole. Production in the early part of 1959 was thus running at 18 per cent above the level of the previous year. According to the Agricultural Engineers Association the rate of advance began to slow down in August and it was expected that the last quarter of the year would show only a relatively small advance on 1958. Output of the various types of agricultural machinery, so far as these are recorded separately, are shown in Table I.

TABLE I.—*UK Production of Agricultural Machinery (Thousands)*

	1955	1956	1957	1958	1959*
Tractors—					
Agricultural types ..	135·2	111·4	147·4	144·1	87·7
Market garden types ..	39·4	27·8	37·9	42·4	35·1
Mouldboard ploughs, tractor drawer	26·6	19·5	22·4	27·8	11·9
Disc harrows	10·1	6·3	8·8	8·8	5·6
Corn drills	3·8	3·0	4·2	3·7	2·7
Farmyard manure spreaders	10·7	6·2	8·4	7·8	3·2
Mowers	19·0	20·0	18·5	18·3	16·6
Pick-up balers ..	10·8	8·0	8·0	13·6	10·0
Combine harvesters ..	6·2	5·1	6·9	6·6	2·6
Grain and grass driers ..	1·1	1·6	1·8	1·6	1·2
Milking machines ..	7·6	10·0	8·2	6·5	4·1
Total (incl. other items and parts and accessories (£ million)) ..	113·5	102·5	130·6	142·5	90·6

* First six months

Exports of agricultural machinery have shown very little change over the last three years. They fell slightly in 1958 but rose again in 1959. The British industry continues to maintain its place as the world's largest exporter of agricultural machinery and in the case of tractors British exports are nearly three times as great as those of her nearest competitor, Germany.

TRACTORS

1959 saw a continued increase in the use of tractors on British farms and by now it is reasonably certain that many farms even of relatively small size have more than one tractor; the average number of tractors per farm is certainly greater than one. There has also been an increase in the average horsepower of tractors in use. It has been frequently asserted in recent years that British farms are rapidly becoming over-mechanised and though, to judge by last year's performance, this is not yet the case, it would now seem reasonable to predict that while the number of tractors used on British farms will continue to increase, the rise will be at a considerably slower rate than has been the case in recent years.

The increasing use of tractors on UK farms in 1959 was accompanied by growing sales of most other types of farm machinery, notably those for the cutting and preservation of grass whether as hay, silage or dried grass. The setback in combine harvesters has been acounted for principally by the fine summer, which enabled farmers to make optimum use of their existing machines without the need for heavy replacements.

Provided there is no serious deterioration in the balance of payments situation, it is unlikely to become necessary to tighten up credit restrictions in 1960 and under the incentive of better hire purchase facilities a further increase in demand for all types of farm machinery is likely. In 1959, one example of the extension of credit facilities was provided by the plans of International Harvester in conjunction with the Forward Trust (a subsidiary of the Midland Bank) to facilitate hire purchase arrangements for the purchase of tractors and equipment through over 2,600 banks in this country. Other banks are thought likely to follow this lead.

The outlook for home sales of farm machinery is, of course, dependent on the prosperity of agriculture. In the past guaranteed prices and other help to farmers have not differentiated between large and small farms, between good farmers and bad farmers or between fertile and less fertile land. Under these conditions the level of assistance necessary to maintain a given output is inevitably higher than would be the case if the efficiency of the more backward farmers could be improved. Small farms are not necessarily inefficient but many require high guaranteed prices if they are to remain economic, because the farmer has insufficient capital to enable him to increase the intensity of his farming operations.

The Small Farmer Scheme introduced last year is intended to help the more efficient small farmers to increase the scale of their operations by means of grants and other asistance. It appears to be the intention of the Government simultaneously to reduce subsidies and guaranteed prices to levels which will permit efficient farmers to operate on an economic basis but will not support the less efficient. The full effect of this policy cannot yet be foreseen but it would appear that a high proportion of farms over 50 acres, with the exception of some hill farms and others with exceptionally poor soil, will continue as economic units and with more intensive farming programmes, while a large number of smaller farms and some of those over 50 acres will gradually be amalgamated or absorbed into larger units. By September, 1959, some 37,000 applications had been received under the scheme out of a total of some 65,000 farms thought to be eligible.

While a reduction in the total number of farms might at first sight seem an adverse factor for sales of agricultural machinery, this may not prove to be the case, since the amount of machinery used depends to a very large extent on the intensity of the farming system. Under the Agriculture Act of 1957 the reductions in subsidies or guaranteed prices which can be made in any one year are limited and the process must therefore be a gradual one. There will inevitably be a steady pressure to improve efficiency and this should lead to increased sales of agricultural machinery provided manufacturers offer the types of machinery required by changing agricultural conditions. In many parts of the country, for example, efficient small scale farming is likely to be dependent on maximum production of grass and forage crops and there may well be a steadily increasing demand for forage harvesters and hay and silage making equipment. The work of improvement under the Small Farmers Scheme will be spread over 5 years and for those who entered the scheme last year, provision is made where appropriate for the purchase of a forage harvester in 1961.

EXPORTS

The export market last year was a good one for tractors. During the first 9 months of 1959, tractor exports at £48·2 million were 8 per cent above the level reached in the comparable period of 1958. This compared favourably with the performance in 1958 when the value of tractor exports rose by only 1 per cent and the actual numbers sent overseas declined. It is estimated that for the full year exports of tractors and parts will have amounted to about £85 million and of other types of agricultural machinery to £16 million, bringing the total contribution of the industry to the country's overseas earnings to rather over £100 million.

A particularly satisfactory feature so far as tractor exports are concerned is the continued high level of exports to the USA. Speaking in September the manager of the Ford Dagenham Tractor Division said that for the full year 1959, UK tractors were likely to show a proportionately better sales performance in the US even than the UK cars, compared with US industry domestic sales. He said that so far as exports of Fordson tractors are concerned, the USA had moved from third to first place, accounting for 17·6 per cent of total Fordson tractor exports to date in 1959. During the year International Harvester announced its intention of importing into the USA tractors made by their British subsidiary in order " to compete in the South Eastern States against a tractor being imported by a competitor". So there is every prospect of a further advance this year in exports of British built tractors to America.

Yugoslavia has also been an important market for British tractor and other agricultural machinery over the last four years. In March, 1959, a further order was received valued at £3·7 million for Massey-Ferguson tractors fitted with Perkins diesel engines and a wide range of implements, accessories and spares. It was estimated that before the completion of this order there were 8,000 Massey-Ferguson tractors and 13,000 Perkins diesel engines operating in Yugoslavia and that the total value of orders received by these two companies from Yugoslavia in the years 1955 to 1959 was £14·5 million.

Exports of other agricultural machinery would have shown a much more substantial increase in 1959 if it had not been for a fall of about two-thirds in overseas sales of combine harvesters. Another factor limiting exports to some extent is the fact that some British companies have expanded their manufacturing facilities overseas. For example, at least a half dozen British agricultural machinery producers have negotiated or are in the process of negotiating for their products to be made in India. Meanwhile, production from the Massey-Ferguson/Standard plant in France continues to expand, while Rotary Hoes have obtained a strong footing in the Antipodes by taking over the full rights and sales of some items of farm equipment from Howard Industries, one of the largest Australian manufacturers of cultivators.

British agricultural engineers are already well established in the markets of the Seven, particularly in Scandinavia and future gains are likely to be marginal. German competition in particular is growing in Europe and according to Professor Heinz Speiser, of Rheinstahl Hanomag, the European Common Market will enable German companies to double their share of the French tractor market. It is claimed that the German industry has an advantage over UK manufacturers in that it can offer at competitive prices tractors designed for the small size of most French farms.

Competition is also becoming more acute in other areas. Exports to the commonwealth, for example, fell last year and while the situation is likely to become easier with the recovery of primary product prices, other countries have been intensifying their efforts in some Commonwealth countries. In Australia, for instance, which was the biggest customer for British tractors in 1958, it has been announced that the J. I. Case company of the USA is to build a £A500,000 plant to make tractors, balers and combine harvesters. Meanwhile, Russia has developed a tea picker which it is claimed will do in one hour the work of 138 first class manual pickers. This may affect the prospects of some specialist agricultural engineers in India.

In South America, where UK exports showed a commendable increase in 1959, the Maschinen-

fabrik Fahr AG of West Germany last year announced plans to increase the existing capital of their Argentine subsidiary with a view to expanding the annual production of tractors to 3,600 by 1964.

On the whole, British manufacturers are well established in export markets, which regularly account for over 70 per cent of their output, while UK know-how on farm machinery is universally accepted as being well in advance of this country's major competitors. To sum up, while competition, as always, is increasing, the industry should be in a favourable position to meet it. 1960 should on the whole be an even better year for exports of agricultural machinery than 1959.

Manpower

Omitting tractors, which for the purpose of employment statistics are included with motor vehicles, the agricultural machinery industry is not a large employer of labour. In September, 1959 total employment amounted to 41,700, an increase of 7 per cent compared with a year earlier. It is, of course, important in an industry reliant to such a large extent on overseas markets that wages and other costs be kept down to enable the industry to compete effectively. The chairman of Ransome Sims and Jeffries, while expressing confidence in the future, said at his company's annual general meeting last May, that "as conditions . . . are becoming more competitive, there is no margin for increased wage rates unrelated to productivity, neither can we support further demands from any source without increasing our prices and reducing our personnel." It seems probable that the final outcome of the wage negotiations in the engineering industry in the current year will be a reduction of about 2 hours in the working day. A large part of the additional cost will no doubt be absorbed in increased productivity but any such settlement may nonetheless create some difficulties for agricultural machinery manufacturers. Industry is pledged to undertake to reduce prices wherever possible and whether it will be possible to respond to official exhortations will depend particularly on the cooperation of the Trade Unions in 1960.

The UK agricultural machinery industry has an excellent name for technical skills and this, of course, is an important asset in competing for overseas markets. To maintain their lead in this respect, the agricultural engineering industry must continue to find ways and means of attracting skilled technicians to the industry. This is recognised to be a matter of some urgency and the new National College of Agricultural Engineering to be built at Silsoe, Bedfordshire, is hoped to channel further skills to the industry. The new college, plans for which were announced in February, 1959, will cost about £250,000 and will provide initially accommodation for between 60 and 100 students. It will provide advanced courses (including sandwich courses) leading to a diploma.

Plant and Products

With respect to investment in new buildings and plant last year was a period of consolidation rather than of spectacular advances although the tendency towards concentration continued. This was particularly reflected in the acquisition of the Standard Motor Company's tractor facilities by Massey-Ferguson, who also purchased the important diesel engine manufacturers, F. Perkins, last year. Massey-Ferguson, who claim to be the largest producers of tractors in the world, are now overhauling their managerial organisation to make their selling more effective on a world wide basis. Further concentration of control was exemplified by the take over of Micron Sprayers by the Birfield Group.

British agricultural machinery manufacturers recognise the value of a high rate of investment and some hint of the importance attached to this was given by Colonel W. E. Phillips, chairman of Massey-Ferguson, who said at his company's annual general meeting that "our investment in the UK and European operations contemplates a very much higher sum than has hitherto been considered in the history of the company. The justification is to be found in the rapid returns through substantial cost saving." Rotary Hoes are also investing in new machine tools and buildings at their main factory, while F. A. Stander and Son Limited claim to have offset increased costs of materials, labour and overheads by improvements in methods resulting from the occupation of new and larger premises.

Materials

For the increase in production envisaged for agricultural machinery manufacturers in 1960, it is of course necessary to ensure adequate supplies of raw materials. Of these, steel is the most important and while supplies have in general been adequate, this has to some extent been made possible by drawing on stocks. During the first nine months of 1959, deliveries of finished steel to the agricultural machinery industry amounted to some 101,000 tons, an increase of nearly 12,000 tons compared with the same period of 1958. During the first six months of 1959, however, stocks of finished steel held by agricultural machinery manufacturers fell by over 3,000 tons which points to some pressure on steel supplies. The supply position should become easier in 1960, although the effects of the US steel strike will continue to be felt throughout the first quarter of the year.

Research

In conjunction with soil scientists, agricultural engineers are now trying to determine the interactions between tillage tools and the soil. This is not as simple as it looks. For instance it would at first sight appear that if an implement pulling a plough were to moae faster, the force requirements would remain approximately the same; instead, there is an appreciable increase in draft. Engineers have now found that this increase in draft is mainly due to the increased shearing strength of soil at higher speeds.

Pressure deformation of the soil under the wheel of a heavy implement is another matter being investigated. Strain gauges have now been developed which can accurately measure the forces of the soil. Measurements so far have indicated that appreciable deformation takes place as much as 20 in below the surface of the soil when a tractor wheel passes over. Engineers are also developing a mathematical description of the forces involved, in the hope that they will eventually be able to predict the pressure effects on the soil for any given treatment.

Automatic control of tractors has been the subject of some highly active research and development both at home and abroad. At Reading University, a group of workers from the Farm Mechanisation Department recently demonstrated a remote control tractor which performed a number of the normal routine tasks of farming.

The variability of agriculture's subject material has not gone unnoticed by the statistician, with his pet tool the computer. The development of statistical methods adequate to deal with the farmer's problems is becoming more and more feasable and the Agricultural Research Council is now energetically exploring the utilisation of computers in this respect. As a consequence of this, the Statistics Department of the Rothamsted Experimental Station as been able to provide an excellent general service to agricultural and biological research workers for the analysis of experiments. The value of this service is clearly indicated by the large amount of requests for statistical analysis from other research institutes both in Britain and abroad.

Automation is a word which can now be said with a straight face in the world of agriculture. At one time it would have been quite a meaningless expression, but now it not only has meaning but is the main hope and aim of many leading agriculturalists. At Reading University they are working now on the development of a tractor which, 20 years hence, should be capable of replacing the farmworker as effectively as the computer can replace office staff. Perhaps by that time computers will have progressed far enough to be able to control the automatic tractors and at the same to tell the farmer which crops and operations he should follow in order to obtain the best yield, or better still, the best profit.

Design

The great advantage of British tractors, and the reason why they are selling so well abroad, is that they are general purpose tools, unlike the German machines, for example, many of which are of a specialised nature. Another reason for their enormous success is that they have, as standard equipment, diesel engines which have proved themselves over the years. A further outstanding point in tractor design is the introduction of row crop wheels, which have a smaller tyre surface, so that they can be used on an ordinary tractor for row crops, like sugar beet. With these wheels it is possible to adjust the width of the track of the tractor to fit any row, and this means that the farmer can work among growing crops without damaging them.

Future tractor developments will include the use of weight transfer units, differential locks and tyres. This means that wheel tractors can be used where formerly it was essential to use a crawler tractor. The implication is that the farmer who, for instance, needed a tracked vehicle for ploughing, can now use a general purpose wheeled farm tractor and thus save on capital outlay. It is too early yet to state that the days of the medium crawler tractor have gone, but the number of applications for them is getting less and less, and these are of a specialised nature.

Nobody yet is feeling anxious about the introduction of hydrostatic transmission, the reasons being simple. It is an economic fact that no firm will be keen to alter basic design until it has run five years. The operation of an hydrostatic transmission probably needs a different skill from a gear tractor and if the driver does not have this skill, the machine will not be so efficient in operation or in terms of fuel. In the long term there will no doubt be uses for hydrostatic transmissions. Manufacturers are now busy developing multi-ratio gearboxes and in the future there is quite likely to be an advance in the number of gears available.

There is no doubt that this country leads the world in hydraulic engineering as applied to tractor design. At the moment the buyer gets, as standard equipment, one set of hydraulics for the rear implements. Another (optional) set is for the implements on the front end of the tractor and another set for power steering. These other two will come to be accepted more and more as standard equipment. The same can be said for disc brakes. Other major trends in tractor design will be the use of more power for the same weight. All the new tractors have more power and 150 to 200 lb less weight and this higher power-weight trend is likely to continue.

Agricultural machinery, as distinct from tractors, is a more complicated problem. In this country we are faced with a continuous waste of agricultural manpower, the 5 per cent of our manpower now engaged in agriculture going down at the rate of 20,000 a year. Hence there is not enough labour to do things traditionally. There is an all-out effort to save manpower, so that a man can do more work, the outstanding movement in the last year being on the haymaking side. Combine harvesters and balers have become well established and amendments to them have not been significant.

Work study shows how much wasted effort there is in the farmyard. The trend in farm machinery is in this direction, with mechanisation and automation in the farmyard, rather than in the field.

Office Machinery

The office equipment industry has a habit of establishing new records each year. The one just ended is no exception. From figures made available for the earlier part of the year the deliveries of office machinery from UK factories in 1959 have been about £60 million. This compares with just over £52 million in 1958.

Exports of machinery in 1959 are likely to have been about £20 million compared with just over £19 million for 1958. As has happened before, the bulk of the increase has been in accounting machines. Electronic computers continue to get the lion's share of the publicity in the popular Press, but it is in accounting machines that the backbone of the industry's turnover is still found. The other two major identifiable categories of office equipment apart from machinery are metal office furniture and metal shelving and racks. It is likely that in 1959 the rate of production of both these types of equipment was round about £10 million each —metal shelving and racks probably being slightly the larger of the two. If these last figures are realised in the event, the value of deliveries of all office machinery and equipment in 1959 will have been slightly over £80 million.

Exports

A feature in the export market has been the rise in exports of accounting machinery to the United States. The industry's traditionally largest market is Australia but through most of 1959 shipments to the Dominion were lagging slightly. It still remained the industry's largest customer, followed with a smaller gap than in earlier years by South Africa and then the United States. India, Canada and Western Europe continue to be useful markets and so far as Western Europe is concerned, international trade is likely to remain important for the industry has an international division of labour which is referred to again later. Western Germany is a special case of a considerable two-way trade in many types of office machinery. This last is, of course, a healthy development from a national point of view at a time when Western Europe is trying to develop its inter-continental trade, both within and without the European Common Market.

In the special case of typewriters, there is a steady expansion going on in the home market. This is partly because of the industrial recovery and partly because the number of typewriters is growing rapidly per head of the population in Britain. There is room for such a growth. In this country only 0·5 per cent of the public own their own typewriters compared with 5 per cent in Western Europe as a whole and 30 per cent in the US. In 1958 there had been, for the first time in the history of the industry, a larger number of portable models delivered both in the home and export market than standard machines. In 1959 total deliveries of typewriters were slightly higher than in the previous year but there was a big drop in portable models sold.

The outlook for the industry as a whole in 1960 is favourable, although there is some prospect of increased competition from imports. So far as these last are concerned, the industry has to face the tendency towards tariff disarmament in the Free Trade Association. In addition the European Economic Community is making rapid progress and one of the industries most likely to benefit within the area of the six countries concerned is office machinery. This is partly because there will be greater rationalisation of the West European office machinery industry and partly because companies from the outside, notably from the United States, are setting up subsidiaries to an increasing extent within the boundaries of the Common Market (EEC). Other markets abroad may expand for this country and the recent successes in the United States may be confirmed by higher exports there. There is no doubt however that countries such as Italy and Germany are going to offer increasing competition in the export of office equipment.

There is a strong possibility that in 1960 the world market for office machinery will expand to such an extent that the export market will become rather like the Caucus Race in "Alice in Wonderland" where everybody ran and everybody got prizes. The next big test in the export market for the British office equipment industry will come when a recession takes place in world markets, whenever that may be.

So far as the home market is concerned, the outlook for the office machinery industry in 1960 is excellent. The basic reason for this is that the economy as a whole is expanding and there are now definite indications that investment by private industry is getting under way. There is thus a favourable base on which to build. Well-established factors making for a gradual expansion of this industry are present. The most important of these are the continuing high level of clerical costs, the increasing emphasis on forecasting and planning, both on the marketing and production side of industry, and the now proven capacity for raising the productivity of the office very significantly by simple, or complicated, mechanical installations and, finally, the high rate of technical progress in the industry itself, leading to partial and large-scale automation.

BUYERS' CHOICE

There are already indications in the office equipment market that the purchaser is becoming increasingly discriminating in his choice of equipment. This means three things in particular. First, he is increasingly determined to check the performance of the machines offered and to investigate alternative machines. Second, there is a growing and welcome tendency in offices to investigate more fully the possibilities of simple yet efficient manual methods before going wholeheartedly, piecemeal and indiscriminately for isolated pieces of office machinery. Thirdly, there is a widespread critical attitude towards servicing agreements and the provision of technical after-sales service by manufacturers. It is therefore quite possible that although the total market for office machinery will expand over this year, individual types of equipment may have to put greater emphasis on the quality of their salesmanship, the standard of their sales literature and the standard of efficiency of their servicing arrangements.

The outlook for electronic computers of all kinds is moderately good though unexciting. British trade and industry, like their American opposite numbers, have found investment in computers requires a fairly lengthy period of investigation and the close examination of alternative models.

A certain wariness has developed as information and gossip has circulated about other people's teething troubles with these machines. It is becoming increasingly apparent that there is a demand for low-priced robust machines which will do comparatively straightforward calculations according to a limited range of programmes. There is, and is likely to continue to be for a very long time, a small market for large, complicated and expensive digital and analogue computers, but the commercial market is going to be something rather different. The one will shade off into the other, of course, over the whole price range but there is a useful commercial market developing for computers for business accounting within the range of, say, £100,000 to £300,000, and there is an even bigger market developing for modest installations, costing so far as the main machine is concerned, something between £15,000 and £40,000 and occupying about 30 to 60 sq. ft of space. In each of these ranges the market is as yet comparatively unformed.

There are two points to be made about labour questions in the office machinery industry. The first of these relates to the industry itself and the second to the industries which it supplies.

Manpower

The industry employs about 45,000 people. Compared with some other branches of the engineering industry it is not therefore a large employer of labour. Its employment contribution to the economy, however, has been made at very significant points. The office machinery industry has set up, notably under US auspices, a number of factories in development areas, such as round Dundee and on Clydeside in Scotland and also in South Wales. One of the biggest British companies has a large subsidiary factory at Castlereagh in Northern Ireland. In terms therefore of employment policy in the development areas, a major preoccupation of the new Government, the expansion programme of the office equipment industry is of the greatest importance.

Probably no other industry has made as proportionately large a contribution to the diversification of industry in development areas as has the expanding office machinery industry.

EMPLOYMENT EFFECTS

So far as user industries are concerned, the significance in terms of employment of the office machinery industry is the effect it has on the demand for clerical labour. A year or two ago, when automation was a household and much-overworked word, there was a fear, especially among the trade unions that the computer and, to a less extent, other office machinery, would quickly create unemployment for clerks. In the event, this is being found to have been a much exaggerated fear. This is because the rate at which highly mechanised systems are introduced into office work in general is slow, in the sense that any redundancy which is created can be largely offset by a high marriage and child-bearing rate among women and a high wastage rate by retirement.

Another reason is that the high pace of technical change at the present time is creating a big demand for improved techniques in planning, forecasting and the coordination of production. In consequence there is a demand for more paper to circulate more quickly. Such a velocity of paper circulation could not be achieved by manual clerical methods. Finally, industrial activity is expanding more rapidly than the number of clerks. On the whole there is plenty of room in the foreseeable future for a large changeover to more mechanised methods in the office and a maintained demand for the services of clerks of all kinds. The impact on labour in user industries is not, indeed, so much a question of numbers employed as the creation of a need for systematic training of clerks. This training must take the form of increased flexibility and adaptability to more than one office routine which in turn involves the up-grading of clerical labour.

Plant and Production

In 1959 the Italian concern Olivetti acquired a 35 per cent interest in Underwood in the United States. Also in the course of the last year International Business Machines has decided to erect a factory in Holland occupying 30,000 sq. ft. In this country De La Rue has entered into an agreement with Compagnie des Machines Bull, of Paris. The latter are considered to be the largest manufacturers of data processing equipment in Europe, and have been negotiating with US office equipment members (notably Remington-Rand) to get a foothold in the American market.

Partly as a defensive measure, Hollerith and Powers-Samas have come together in the last year to form International Computers and Tabulators. This brings under one organisation the two distinct and formerly competitive

punched card systems—Hollerith, an electrical system, and Powers-Samas, a mechanical one. This concentration in bigger units is also evident in the coming together of Elliott Automation and National Cash Register in one company. In this case the sales organisation of National Cash Register has been grafted onto the production expertise of Elliott. The result has been, to judge from the evidence so far available, to produce an exceedingly viable and highly competitive group in the computer market

When a count was taken in April, 1959, of the number of computers already installed these last two groupings accounted between them for 37 out of 51 installations in the UK so far as commercial-type computers were concerned. In non-commercial computers English Electric and Ferranti accounted for the lion's share of the market. So far as electronic calculators are concerned, a count taken at the same time showed that IBM (United Kingdom) accounted for about 100 installations and International Computers and Tabulators for 53.

Taking digital computers as a whole, International Computers and Tabulators are credited with 90 installations in Britain: Elliott Automation with 60, Ferranti with 50, IBM (UK) with 46, Standard Telephones and Cables with 21, English Electric with 15 and Leo Computers with 9.

At the "light" end of the industry (and this may be taken to include typewriters, duplicators, smaller machines for speeding the flow of communication through the office, whether on paper or otherwise) the prospects depend to a large extent on the continuation of boom conditions in the UK. So far as this end of the industry is concerned the outstanding factor is the probability of increased factory and office capacity being installed in the next year or so. This will give the office equipment industry an excellent opportunity for raising turnover but, as has been said already, demand is likely to be selective.

Some sections of the office equipment industry can expand very significantly by sub-contracting the manufacture of small components. To that extent it behaves not unlike the aircraft industry.

Materials

The office machinery industry is mainly concerned with the mechanical techniques, design problems and, in some degree, with weight. Since the advent of a large range of plastics materials, the industry has been able to develop technically well enough with an adequate supply of sheet steel, plastics and dyes.

Materials for any industry can be looked at from two points of view. There is the question of supply and price and of the impact of materials on the rate of technical change.

For the first of these steel supply (even in its tightest days after the war) has not been a major problem for the industry. The range of plastics now available ensures that no shortage is likely to develop. Steel continues to encounter competition from lighter metals and from plastics in casings of machines, non-working parts, visual aids and office furniture but its position remains secure in the structural parts of most machines and for most working parts.

GERMANIUM TRANSISTORS

In technical change the application of raw materials to technical problems continues to exercise attention. A key point is the development of transistors for electronic office equipment. The development of transistors from germanium has been a major development over the last few years in electronics, offering significant improvements in weight, robustness and simplicity of assembly. In 1959 there were reckoned to be 800 transistors and semi-conductors in production (with applications far beyond office machinery, of course) giving a world output of 100 million units last year, 25 per cent being in the UK. The transistor has gone into mass production and its raw material basis has gone beyond germanium to silicon, indium phosphate, antimonide and arsenide.

Chromium has begun to attract attention as a raw material (in a magnetised form) for masers. These are small devices for detecting micro-wave signals down to the smallest theoretical strength. They consist of a small synthetic ruby, for example, which is non-magnetised and into which a few atoms of magnetised chromium are introduced. The first maser (which stands for microwave amplification by stimulated electromagnetic radiation) was constructed last year by Mullard Research laboratories in cooperation with the Royal Radar Establishment. Masers have been developed so far to operate at near absolute zero temperatures in liquid helium. The next development of outstanding importance will be to make masers operate efficiently at ordinary temperatures.

Among dyes, used in reproduction processes, the trend is for better reproduction and cleaner handling, especially in wet-process techniques. The same applies to both spirit-reproduction and photographic reproduction techniques.

Research

Behind the scenes, in the office equipment industry, the wheels of research and development are turning swiftly and surely. Where once research was unheard of it is now the life-blood of an industry which is rapidly reorientating the methods of the world's administrative offices. Most of this research and development effort is being spent on one particular branch of the business computers.

Today's computers are nearly a thousand times faster than those of three years ago. Even more staggering is the fact that in the last decade computer speeds have risen by a factor of about one million; and these speed increases continue. Where research engineers once aspired to obtaining speeds of the microsecond order, they are now discussing the technicalities of nanosecond (millimicrosecond) working. Bearing in mind these rates of progress, there can be every expectation of even faster machines during the coming year.

Although the speed with which computers carry out their work is the main reason for their success, further developments in this direction are not the only ones of importance. Miniaturisation and reduction of power consumption are factors requiring equal consideration. In both of these cases it is the solid-state physicist who is coming to the rescue.

Where, only yesterday. the thermionic valve consumed watts of power and cubic centimeters of space the transistor takes its place, consuming only milliwatts and cubic millimeters. But, once again, this phenomenal rate of progress has not reached saturation point. Research physicists in America are now working on a tiny semiconductor element which consumes energy of the order of one-tenth of a microwatt. They say that their aim is to produce integrated electronic elements so that 100,000,000 computer functions could be carried out in one cubic foot of space. In fact, at the world famous RCA research centre, they are now speaking of miniaturisation to the extent that computers such as the renowned IBM 704 (which is about as big as a garage for one car) could be made to fit on a desk.

Speed of switching is the factor which ultimately limits the working speed of a computer; but there need be no fears that this will ever be a stumbling block, for research has now produced a device which will enable the ultimate speeds to be reached. Known as a superconducting element, it is one of the scientific wonders of the age—it achieves a form of perpetual motion. Worked at temperatures close to absolute zero, it is believed that these devices could form a memory store that would operate near to the maximum possible speed of random access, set by the limitations of the speed of light.

At an international conference on computers, held in June last year, experts were discussing machines that would control ther machines, predict the weather, translate languages, send rockets into space, and solve problems that would take a skilled mathematician a whole lifetime to solve.

Design

Britain's office equipment industry is the largest in Europe. It produces more than any other country (except the USA) and a wider range of equipment than any other in the field. We are selling in three-quarters of the countries of the world.

The industrial designer is playing a big part in the development of office equipment, particularly in the USA. In Europe there is less emphasis on dominant shapes, except in the case of Olivetti in Italy and the Swedish firm of Atvidabergs, in consultation with the industrial designers Count Sigvard Bernadotte and Acton Bjorn.

Unfortunately, most of the good typewriter designs seem to come from abroad. In fact, it would not be far wrong to state that these foreign designs completely dominate the market here and that British designs compare most unfavourably with the clean lines and compactness of the best designs from abroad. This does not mean that our machines are not as good mechanically as the foreign ones.

Among typewriters seen during 1959, these are of interest: Imperial Typewriter Company Limited, unveiled a prototype electric typewriter, to be in production next year. Another electric typewriter, featuring proportional spacing—a particular space is allotted to each letter according to its outline—was shown by Remington Rand Limited. One typist can operate four typewriters at once with the Auto-Typist, and by pressing buttons turn out 500 individual typed letters a day (British Equipment Limited). Underwood Business Machines have a portable typewriter with a scale that shows the exact number of lines to the end of the page and fitted with a jam release key for freeing entangled typebars. Vari-Typer Limited have an electrically-operated machine with which it is possible to change the type-face several times when preparing a document, all quite quickly, while Smith-Corona (Great Britain) Limited have portable typewriters that weigh less than 9 lb, all in fashionable shades. Olivetti introduced their somewhat controversial 82 model Diaspron and the German Primus portable is typical of the possibly unpretentious designs of that country.

In the duplicator field, Britain is among the world's leaders, and many of our machines have been simplified and streamlined to give them the necessary aesthetic appeal. The Gestetner 360, styled by Raymond Loewy for simplicity of operation, is an electrically-operated stencil duplicator, self inking and fast to use; the Fordigraph transportable inkless duplicator is a spirit duplicator with the ink supplied from a series of jets. Others are the Block and Anderson Banda, the Ellams ER2 and the Swedish Plento duplicator, a hand operated spirit duplicating machine with a good appearance, designed by the Bernadotte and Bjorn team.

REMOTE CONTROL

A remote control dictation system makes it possible to use ordinary Pax telephones as microphones to give dictation to the machines in a typing pool (Aga Dictating Machine Company Limited). Printed circuit dictation equipment with all-purpose recorders and transcribing aids, with a finish that is immune to salt water, hot tea and sunlight, comes from Assman Dictating Systems. From Germany there is the Stenorette B dictating machine with rechargable nickel-cadmium cells for powering the transistor circuits, probably the cheapest machine on the German market, and the Olympia Business Machines Company's latest dictating machine, which weighs only 5½ lb and has many technical advances.

Buying Pattern

Before he lays out much money on producing a new product every manufacturer wants to know how many are likely to be sold. The making of jigs and tools needed, if the item is to be made in quantity, is a very costly business and a mistake could loose a lot of money.

The pattern of spending by consumers changes. There are many causes: change in income, in taxation, in education and in outlook generally, all have an influence, occasionally unexpected. Some of these causes were taken into account by Dr. Mark Abrams when he tried to give the British Institute of Management a picture of consumer spending*.

One of the points he made was that the pattern has changed twice in the last 15 years. Immediately after the war the tendancy was to spend more on entertainment; during the last few years this has changed to buying more durable household goods. He forecast that in the next decade with the steady increase in income that is expected, the consumer will probably tend to spend even more " on making his home cleaner, warmer, brighter and better equipped so that apart from his weekly drive to the seaside or the country he can spend even more of his time in a comfortable home withdrawn from direct contact with the outside world."

The consumer is becoming more discriminating too. Sales have always depended to a certain extent on the appearance of the article but never more so than now. Moreover any improvement that will give the housewife less work has a big sales value—witness the popularity of washed vegetables packed in transparent bags, of frozen food and ready mixed cake ingredients. Although these must necessarily cost a little more, with his increase in income the consumer is prepared to pay for them, just as he is prepared to pay nowadays for such items as washing machines and dishwashers which reduce the heavier chores in the home.

Thus it is that Dr. Abrams leads up to the implication that " the safest working principle for almost every producer from now on is to trade up in the quality and design of his product " —an aim that surely every responsible firm always has in mind anyway. Yet it is surprising what design defects still exist and still occur even in the latest items—defects which a day's trial in the home would have revealed at once. Take for example spin dryers. Not just one but several makes of these in their first models had the drain outlet so low that it was not possible to place a bucket under it to catch the water. Such a result can only suggest a designer living in a world of his own, remote from reality—a picture that many production engineers would heartily endorse.

The same point was made, though in rather different terms, at a recent meeting of the Southern Electricity Consultative Council. One of the Council's delegates to the British Electrical Power Convention quoted a cooker with an eye level grill as an example: it had a number of defects that any experienced housewife should have been able to point out to the manufacturers. It emphasised the need for more user consultation in the production of domestic appliances.

Such consultation should obviously take place at quite an early stage in the design for it might influence the engineering aspect considerably. However perfect the mechanism of one of these household machines may be, it is useless if the ordinary housewife cannot operate it conveniently. Indeed convenience and simplicity of operation can override greater efficiency—and even safety—when the final choice is made.

The question of convenience or good design is not considered by the Gas Council, the British Electrical Development Association or the Coal Utilisation Council in the goods that they officially approve. They are concerned with fundamental questions of safety and conformity to British Standards where these exist. Nor do they make any comparison of efficiency. For performance figures and criticism the public has to rely on bodies such as the Consumers Association (publishers of *Which?*) and the Consumers Advisory Council (publishers of *Shoppers Guide*). A new body is being set up charged with forming an organisation to protect and safeguard the British public by approving domestic electrical appliances and by maintaining and publishing a list of appliances so approved. Each appliance will be marked with a seal of approval and such approval will be based on a British Standard. As it does not seem that these lists will contain any critical matter regarding performance and efficiency, the consumer will still have to rely on the bodies already mentioned in order to make a discriminating choice.

In 1958 there were 1,470,000 incomes in the range from £1,000 to £1,500 per annum, nearly twice as many as were earning the equivalent amount in 1949. Tax deduction was less on average as well—only 12 per cent as against 17 per cent, a figure that was reduced still further by the last Budget. Dr. Abrams estimates that after meeting income tax and insurance and putting aside something for savings, the average family in this group spent £19 per week in 1959. His estimate on how this expenditure was divided is shown in Table I which is for a family of three —father, mother and child.

TABLE I.—*Weekly Expenditure of the Average Family in the £1,000 to £1,500 a Year Group, 1959.*

	s d	Per cent
Food	106 0	27·8
Beer, wines, spirits	13 3	3·5
Cigarettes and tobacco	26 6	7·0
Housing (rent, rates, repairs, mortgages)	45 6	12·0
Fuel and light	20 6	5·4
Clothing and footwear	38 0	10·0
Household goods	36 3	9·6
Books, newspapers, etc.	6 6	1·7
Private motoring	25 0	6·6
Other travel	14 0	3·7
Entertainment	7 0	1·8
Other goods and services	41 6	10·9
Total	380 0	100·0

TABLE II.—*Proportion of Total Households Owning Various " Durable " Goods.*

—	1948, per cent	Autumn, 1958, per cent
Television set	1	62
Refrigerator	4	13
Washing machine	3	28
Vacuum cleaner	34	65

It seems fairly probable that the comparatively high rate of spending on household goods—9·6 per cent—will continue for several years to come. The market is by no means saturated as other figures quoted by Dr. Abrams and reproduced in Table II show. In particular the working class market is virtually untapped for most goods though television sets and vacuum cleaners have far outstripped refrigerators, toasters and washing machines. Conservatism at home (if not in politics) is a well known working class attribute.

The picture for the producer would therefore seem to be a rosy one. Although the £1,000-£1,500 a year group is now only about 10 per cent of all British families, it seems quite probable that by the middle 1960's it will include the majority of working class households. As Dr. Abrams says, the manufacturer can " operate on the safe principle that today's affluent consumer is tomorrow's average consumer." But it also seems probable that he will be a very discriminating buyer.

* " The Changing Pattern of Consumer Spending "; Paper presented at the National Conference of the British Institute of Management, held at Harrogate.

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Published every Friday by Engineering Ltd. at 36 Bedford Street, London, WC2, England.
Telephone: Temple Bar 3663.
Telegrams: Engineering Lesquare London.

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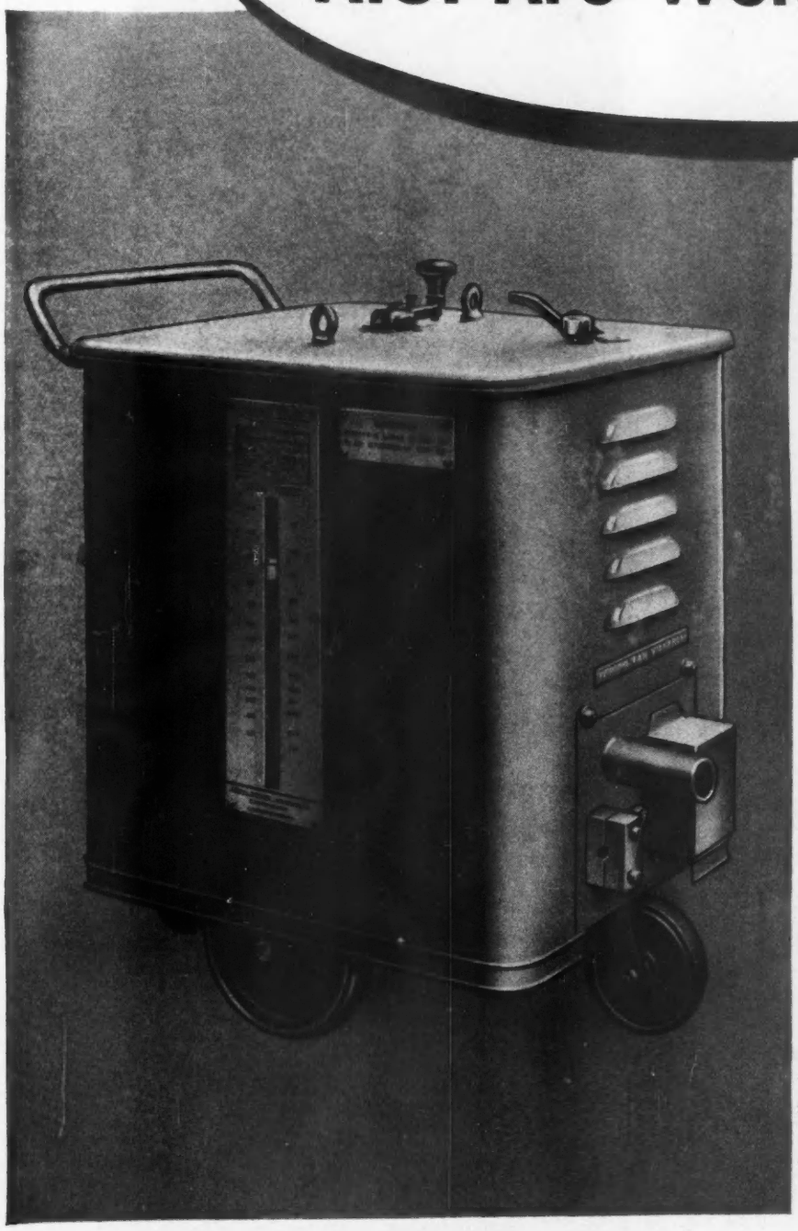

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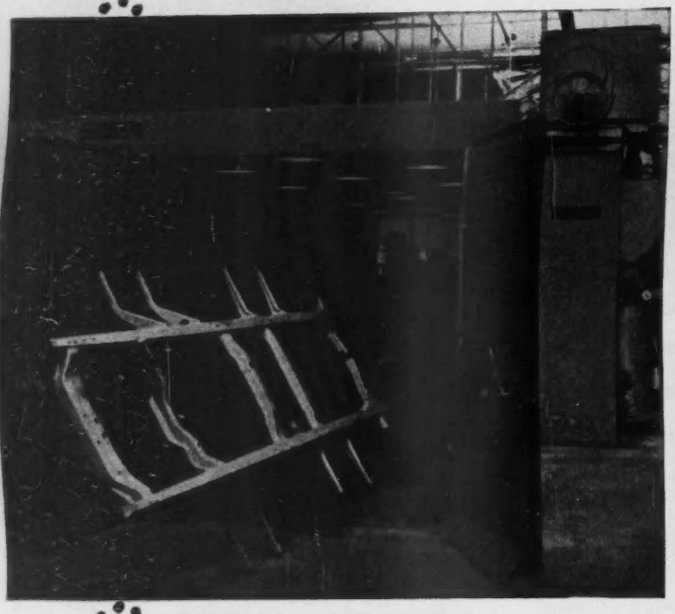

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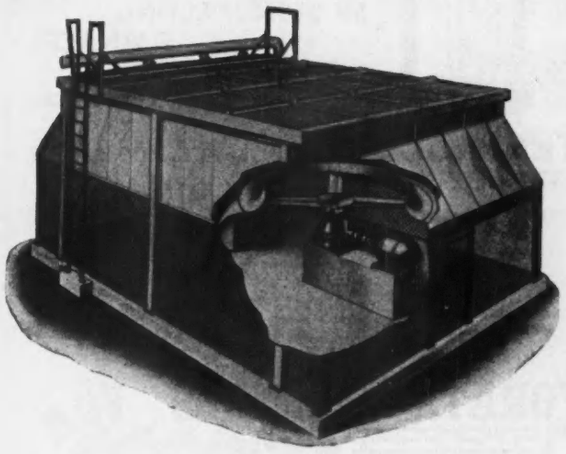

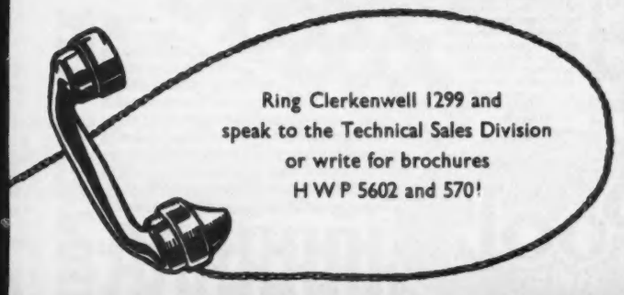

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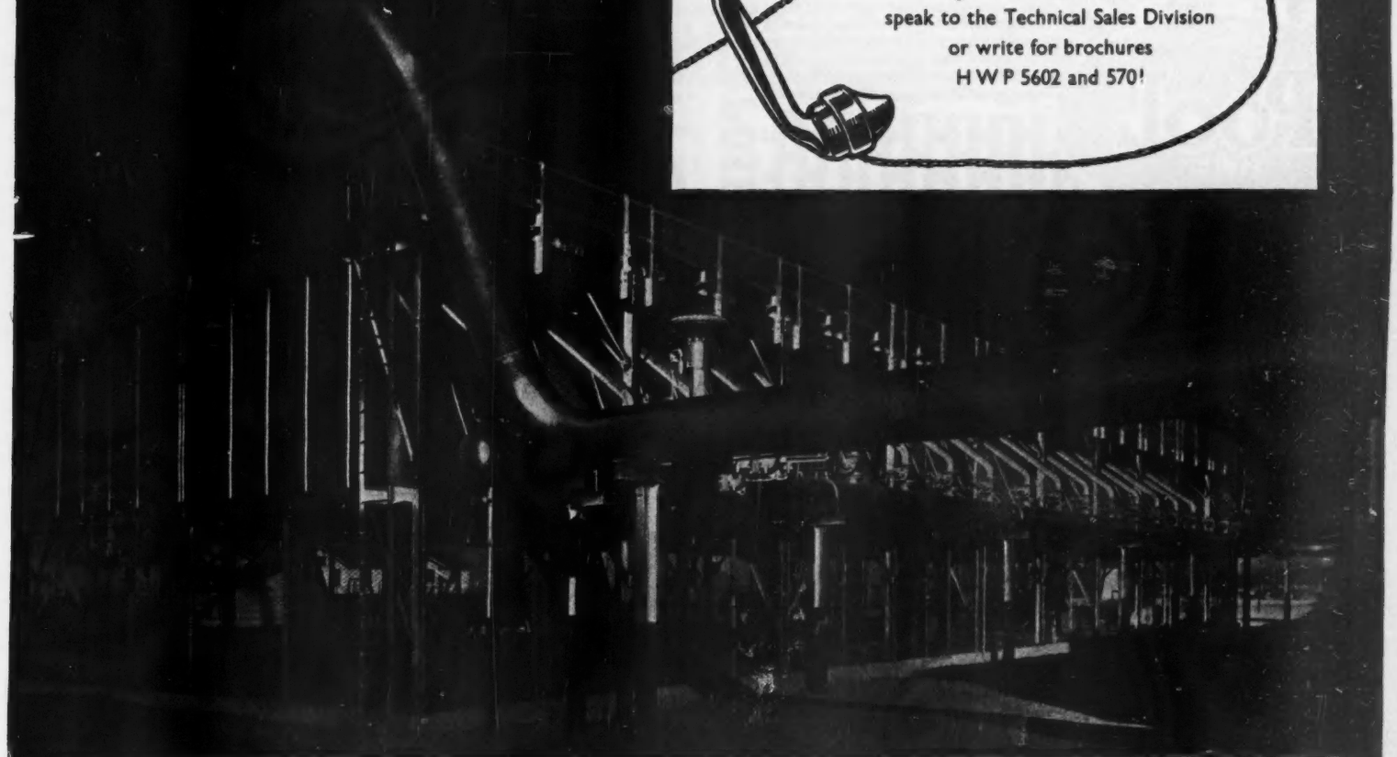

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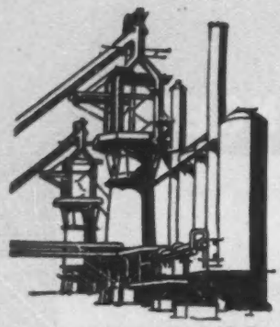

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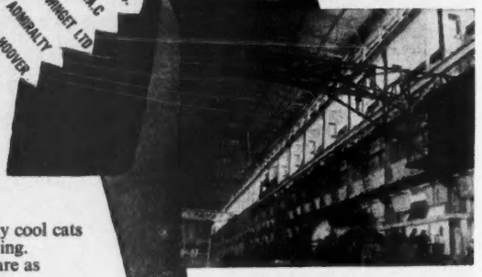
The picture shows one of two Clayton wall cranes specially designed for Messrs. British Thomson-Houston Ltd. for general assembly work on turbo alternators. Two overhead travelling cranes of 75 and 150 tons capacity take care of the heavy lifts.



Big manufacturers are pretty cool cats when it comes to crane buying. Habitually their standards are as exacting as their demands are imperative. Sizeable cool cats don't swing for nothing and the Clayton organisation doesn't intend to fall short of what it takes to keep 'em swinging.

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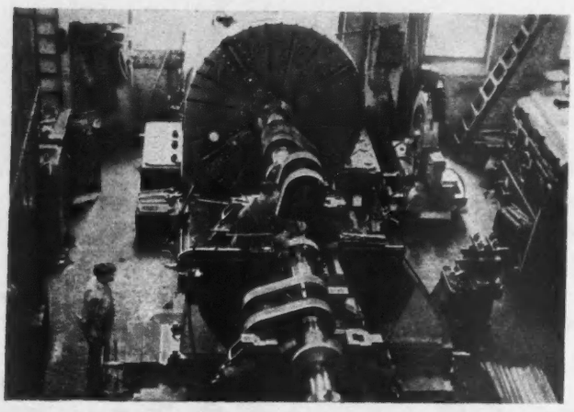

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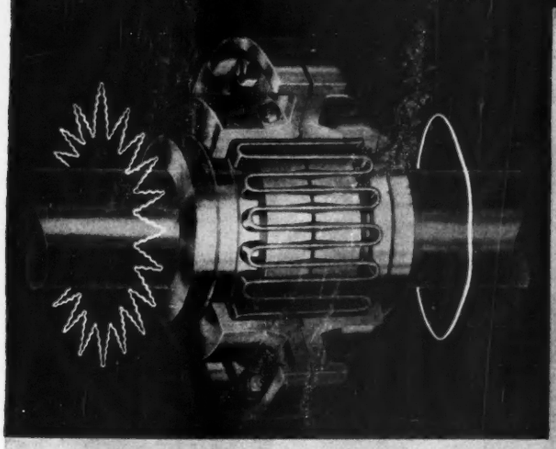

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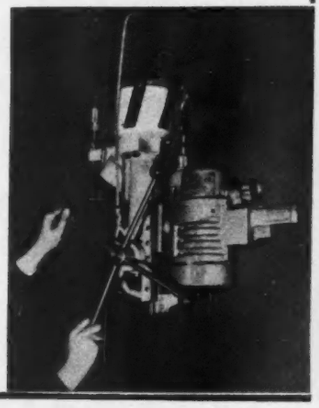

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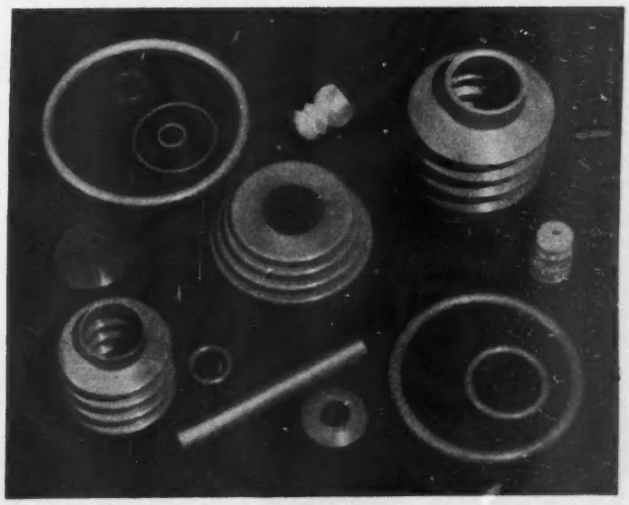

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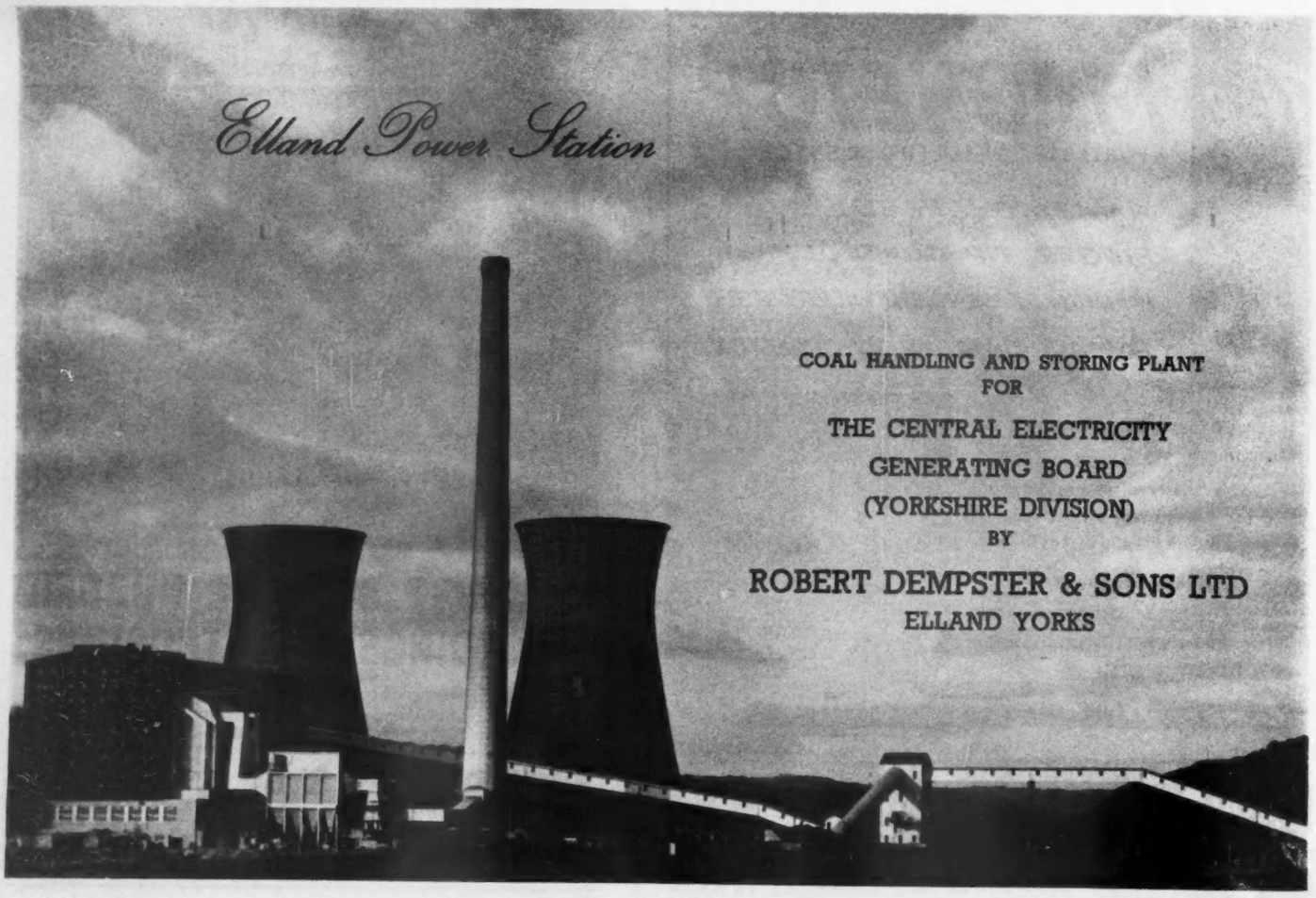

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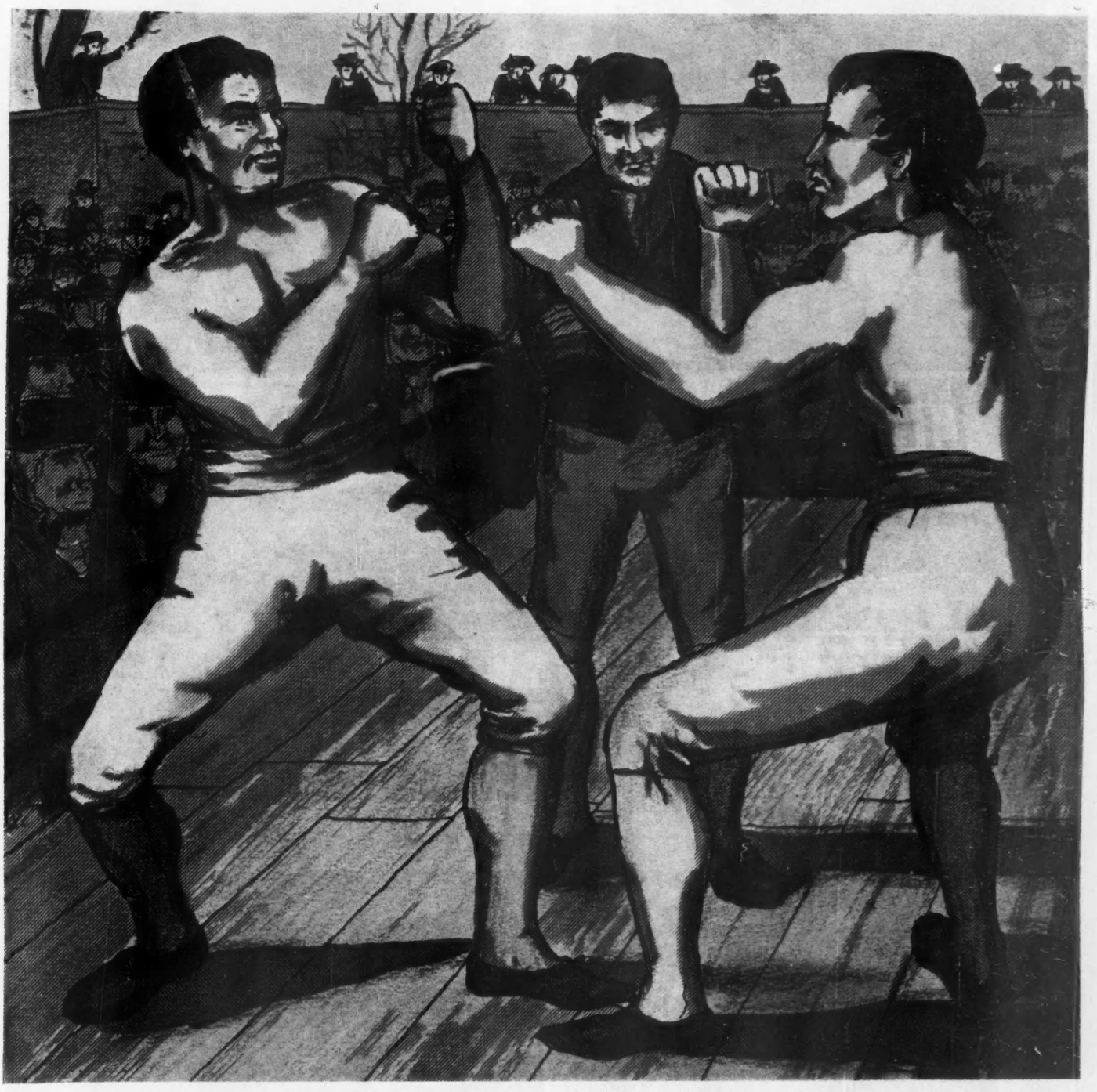

The story of the manly art goes back through the mists of time, and many a Village Green echoed the crash of bone on flesh while brawny bruisers and fine young bucks pounded their prowess in the Englishman's National Sport. Because of dreadful injuries, bare fist contests were eventually stopped by the law, and gloves or 'mufflers' were introduced, thus protecting the fighters and often preserving their very lives.

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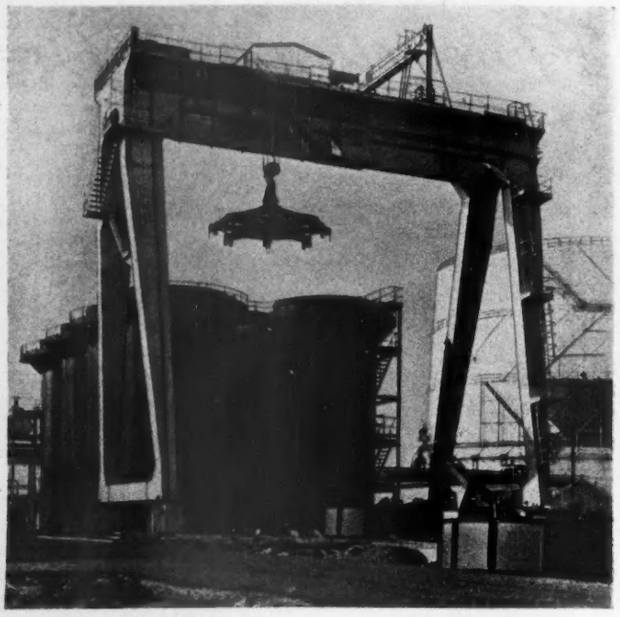

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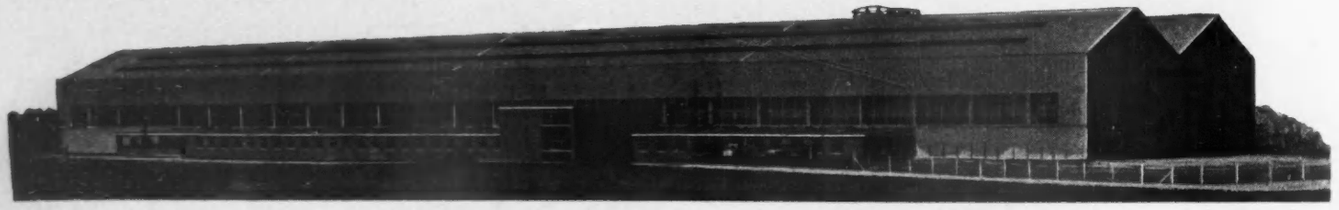

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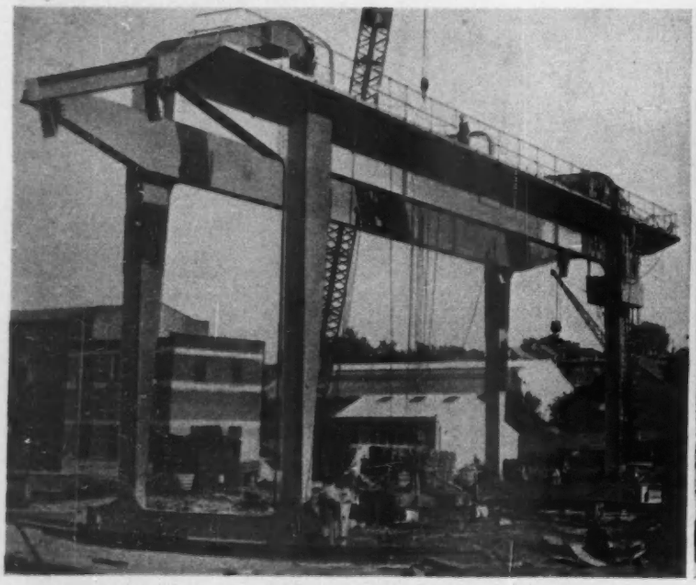
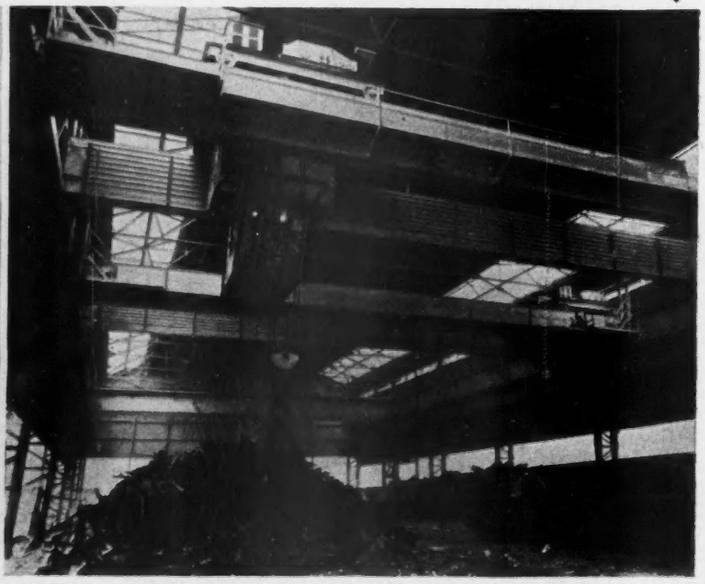


3-10 Ton Scrap Bay Magnet Cranes



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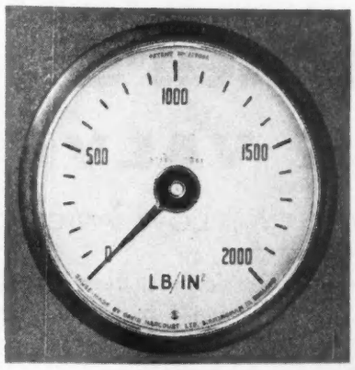

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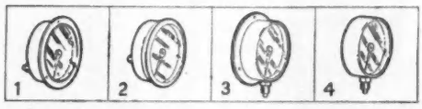

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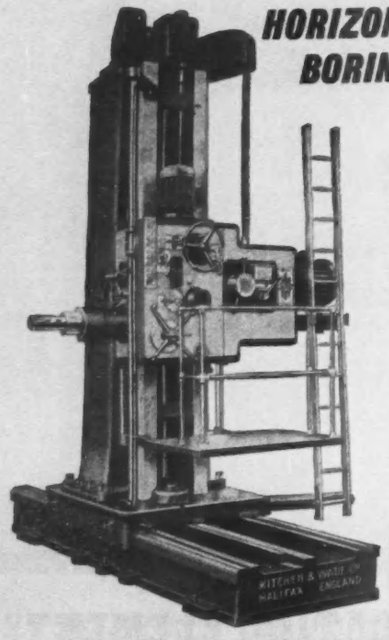

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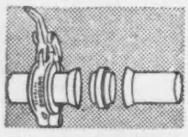
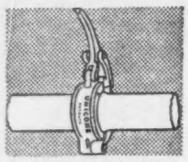
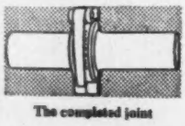

Rubber gasket in position and joint ready to pull over


Pipe ends joined ready for locking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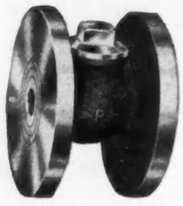

1043 FLANGED HORIZONTAL CHECK VALVE

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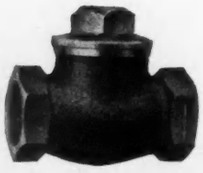

1039 HORIZONTAL CHECK VALVE

Lifting type. Prong-type metal valve. Sizes ¼"-2"—Female ends tapped BSPT (taper) BS21. 2½"-4"—Female ends tapped BSPT (par) BS84.

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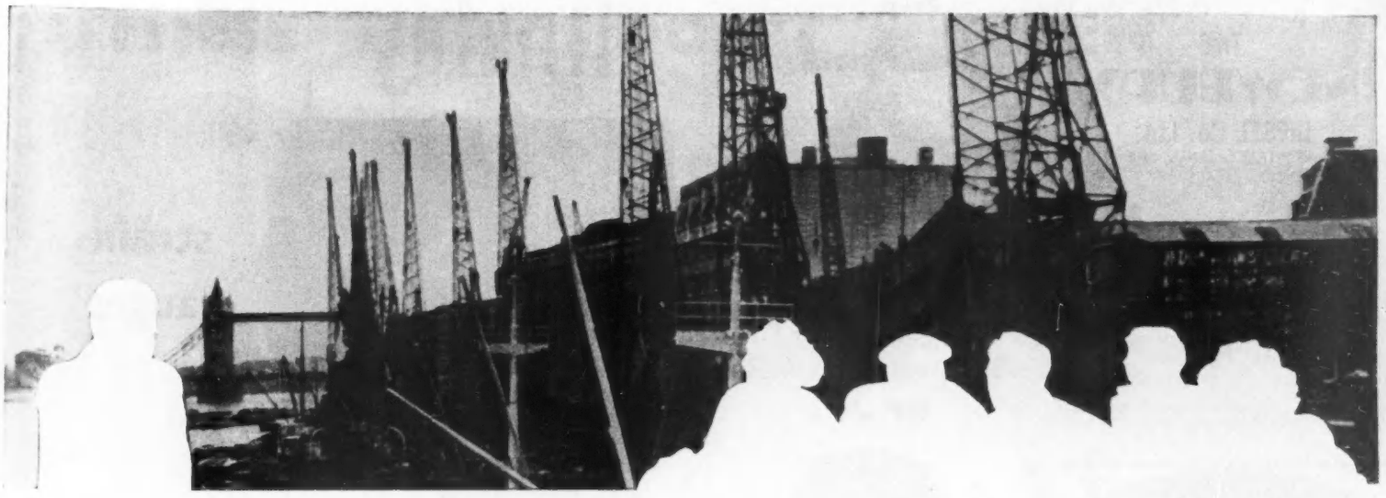

watching the cranes go high

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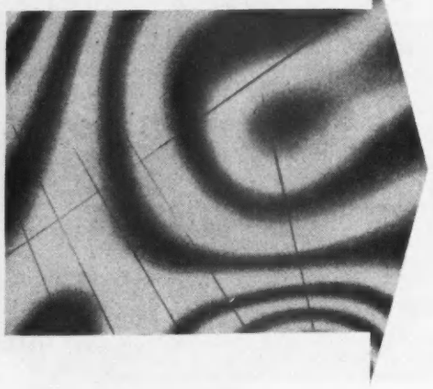

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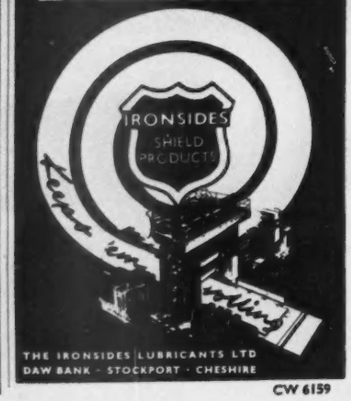

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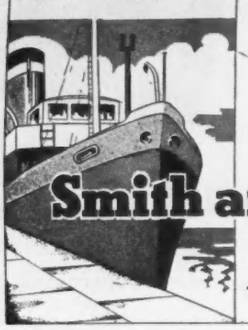

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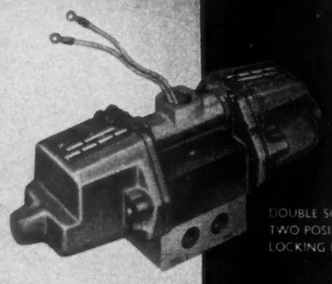

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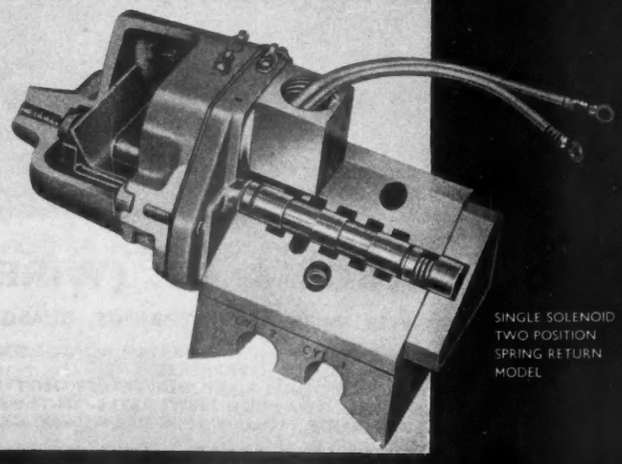

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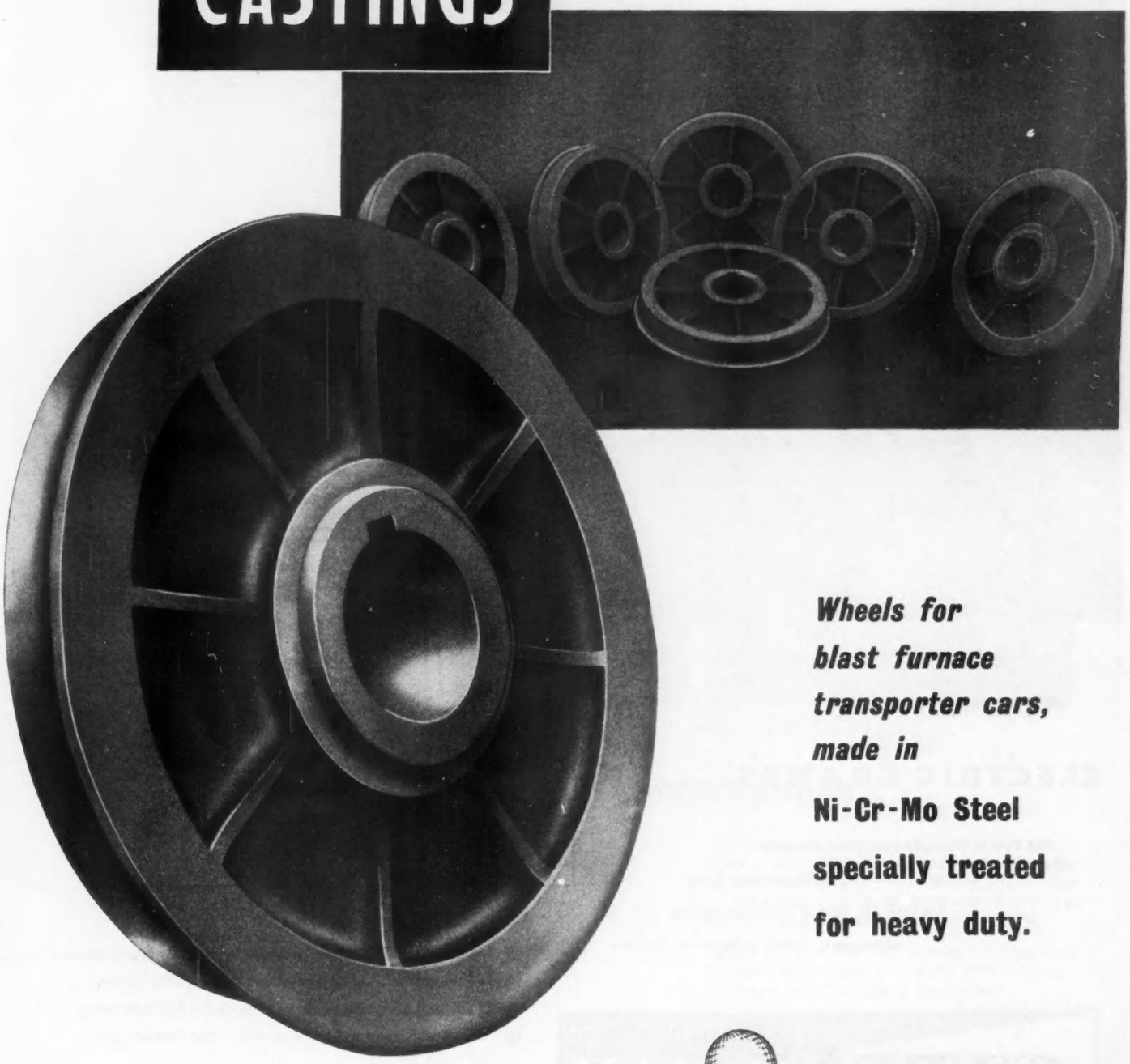
STEEL CASTINGS



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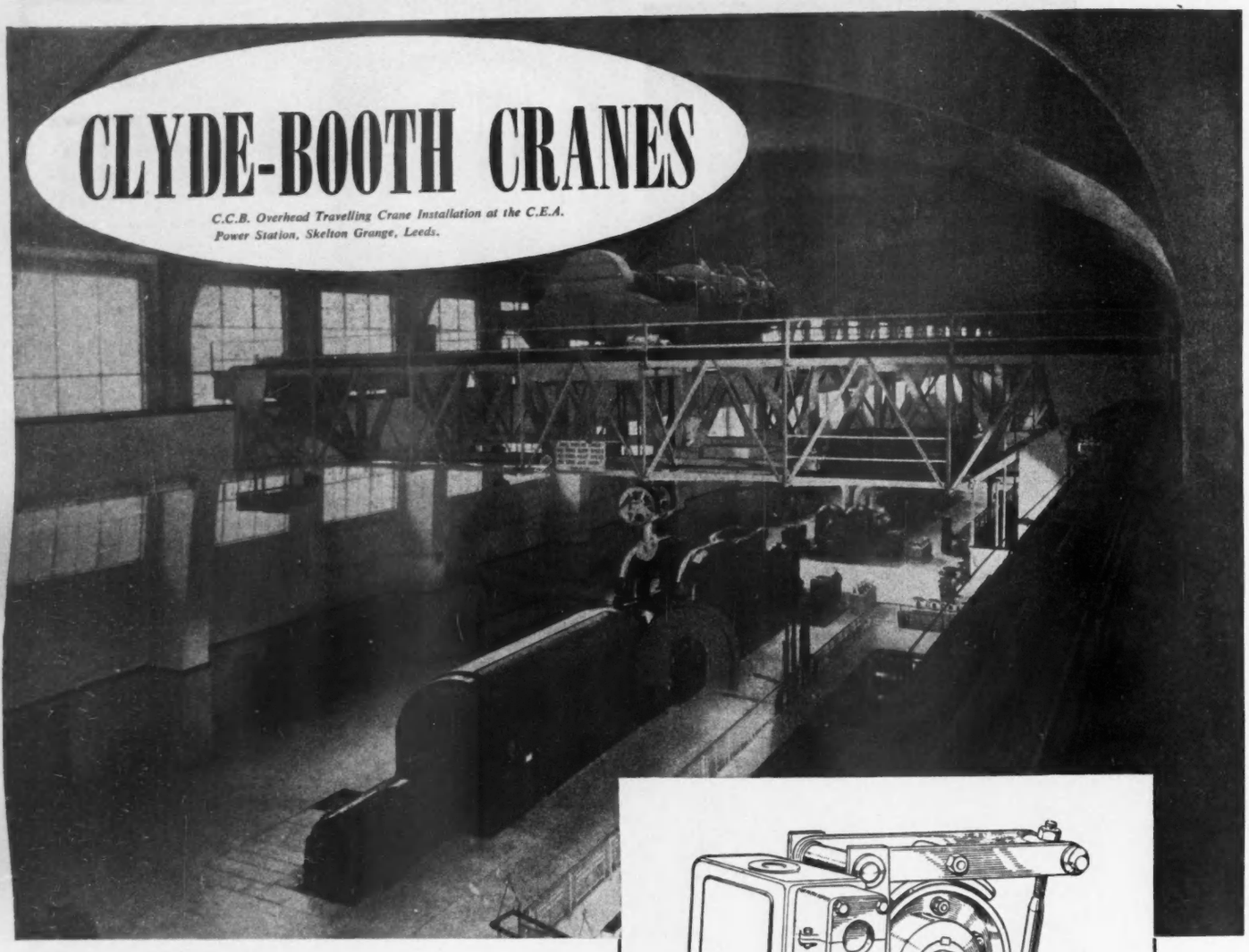
CLYDE-BOOTH CRANES

C.C.B. Overhead Travelling Crane Installation at the C.E.A. Power Station, Skelton Grange, Leeds.



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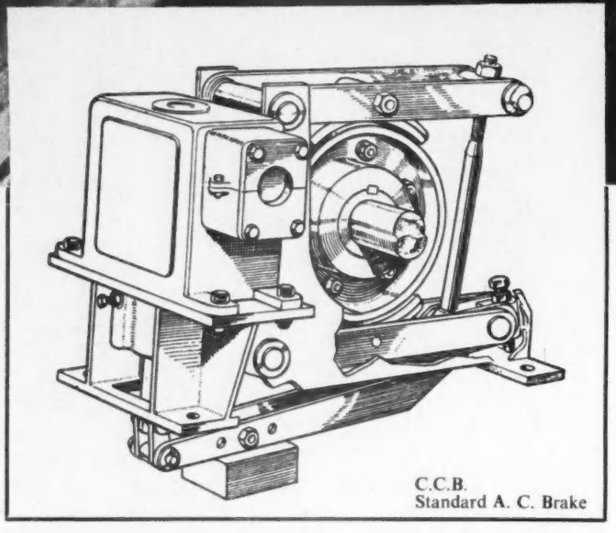

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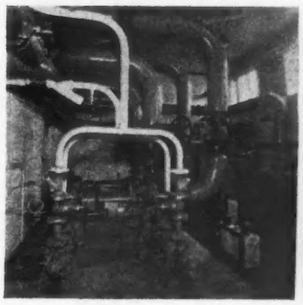
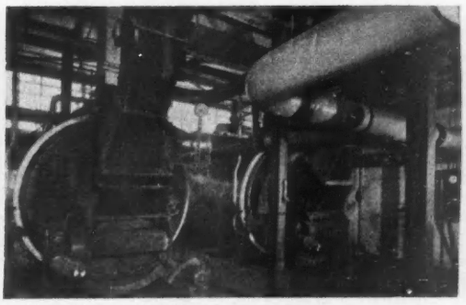
High-pressure hot water pumping arrangement.



Two double pass economic boilers, each 6,000,000 B.t.u's per hr—chain grate stokers and coal and ash handling plant.



Architects: Wm. and T. R. Milburn, Sunderland.
Consulting Engineers: Cairns and Byles, Newcastle.

STEELS

heating & ventilating installations

This installation of high pressure hot water, general space heating and service pipe work for **Siemens Edison Swan Ltd.,** T.V. Tube Factory at Sunderland is representative of Steels' many and varied installations throughout the country.

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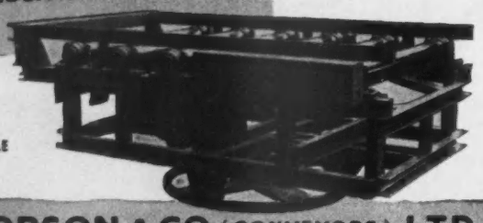

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Monitors the Blow-down Continuously.
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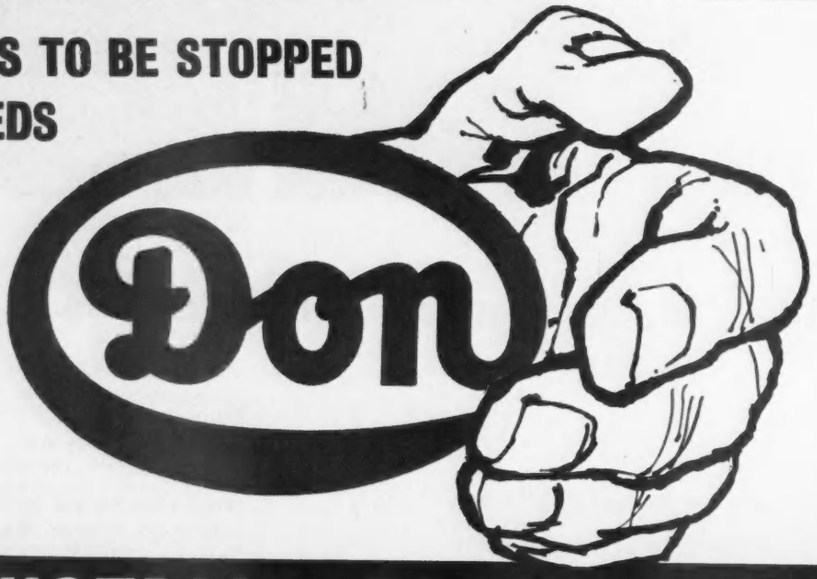

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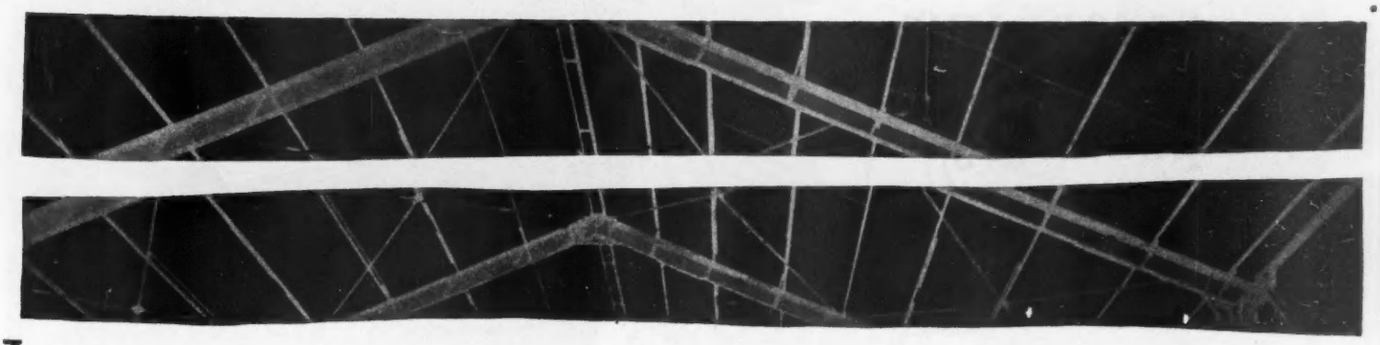
IBL 14

FABRICATION · ERECTION · DESIGN · FABRICATION · ERECTION · DESIGN · FABRICATION · ERECTION · DESIGN · FABRICATION · ERECTION · DESIGN ·

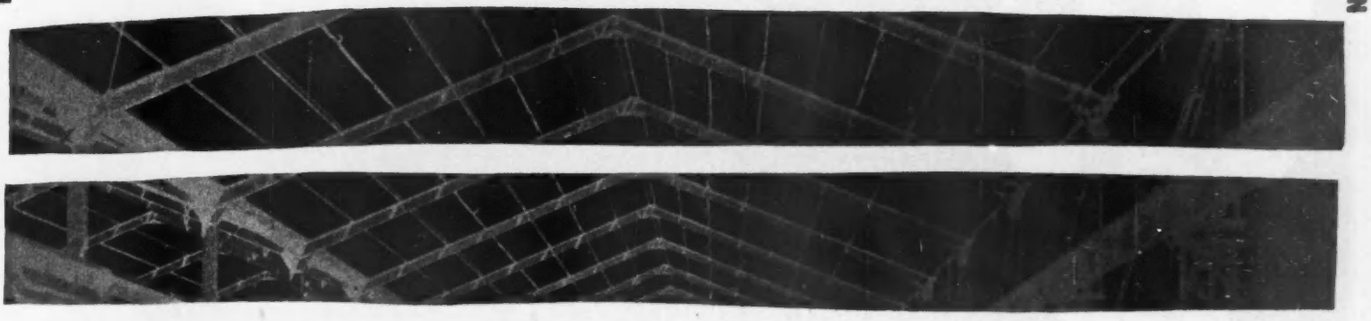
The Portal Roof...



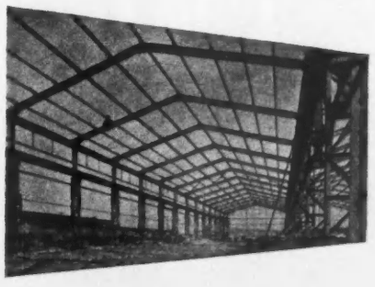
. . modern construction for the modern factory . . . .

Ever in the forefront of modern development, Lambhill show this example of a welded Portal Roof—a twin—span construction with spans measuring 70 ft. by 500 ft. giving maximum unobstructed headroom. There are no members below the rafter line to accumulate dust and dirt; the construction permits easy complete insulation. Maintenance costs are low.

DESIGN · FABRICATION · ERECTION



DESIGN · FABRICATION · ERECTION



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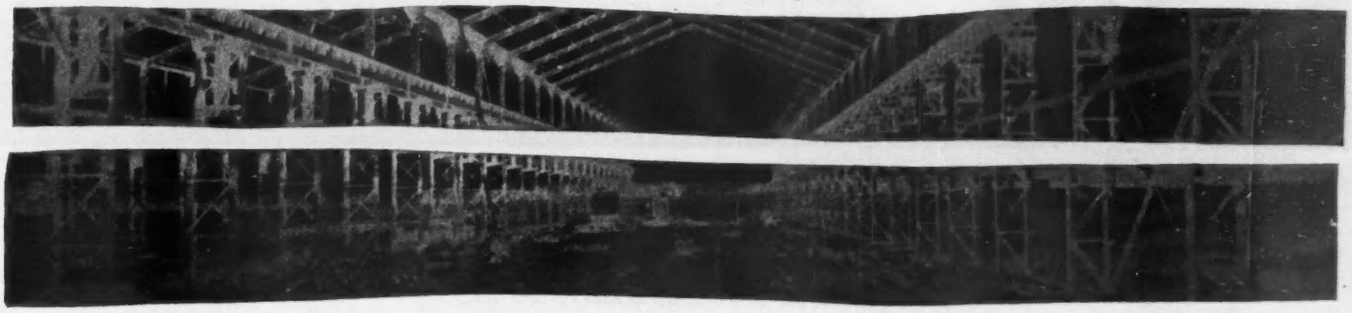

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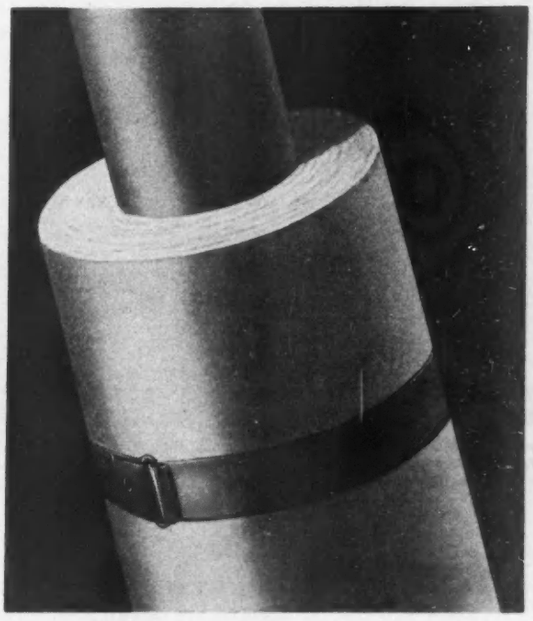
From all over the world, samples of ore are continually arriving at the G.E.C. Laboratories for testing. Reports and recommendations from this source have earned an enviable reputation for thoroughness and reliability.

"I was Cool, Man, Cool!"

'Steamy' Pipe reminisces

"It's my job to carry steam — and to keep it at s-s-s-steam heat. But I was falling down on the job — as flat as an old fashioned waltz at a Rock 'n Roll Rally. I was losing heat. Wasting fuel. Throwing away money. If I hadn't been so round, you could have called me a square. What a difference when they fitted me from top to toe in Fibreglass Rigid Sections! Man, these sections are really something! They're light; they're trim; they go on easily and stay on permanently. Since they came along, I've been the savingest pipe in the business; *and* I keep the steam just as it should be — piping hot!"



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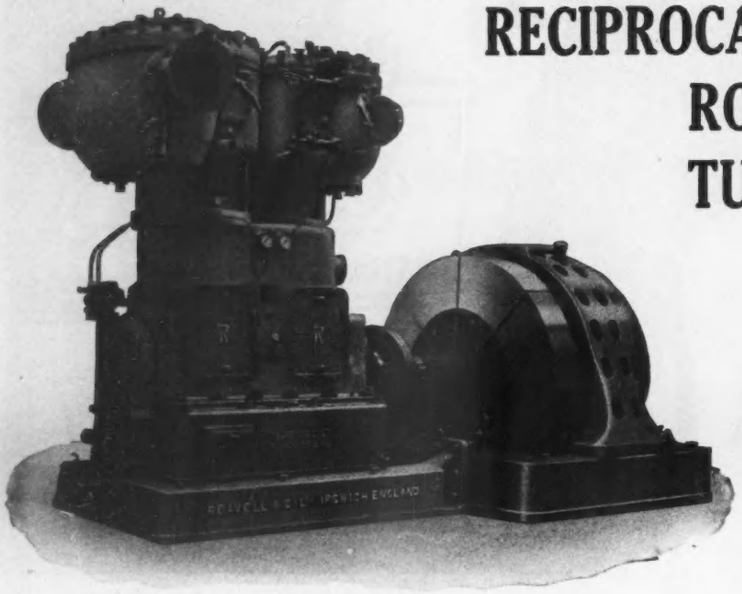

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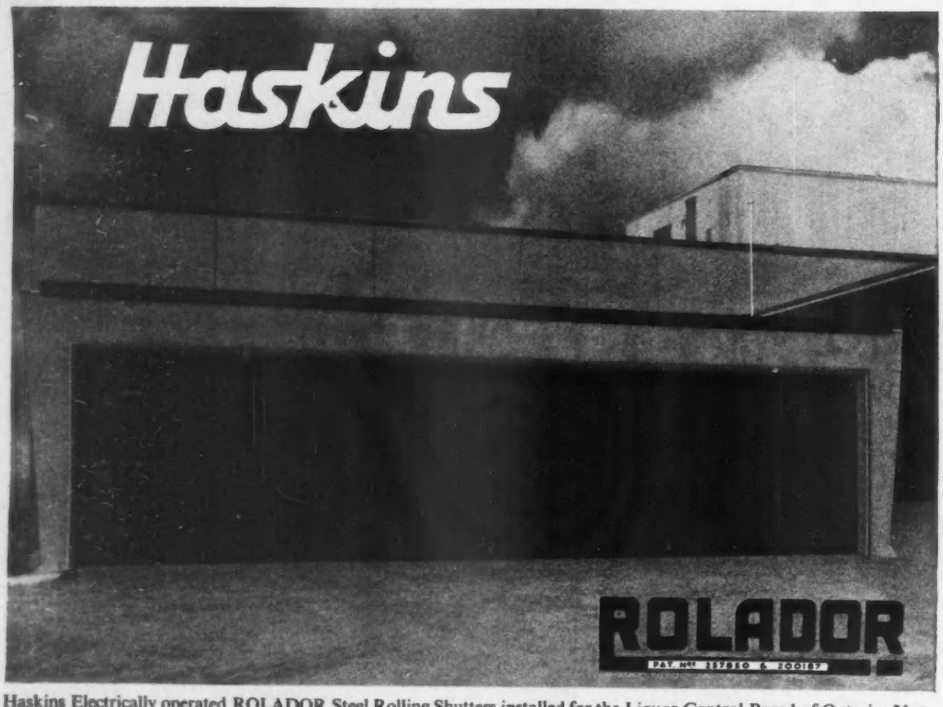
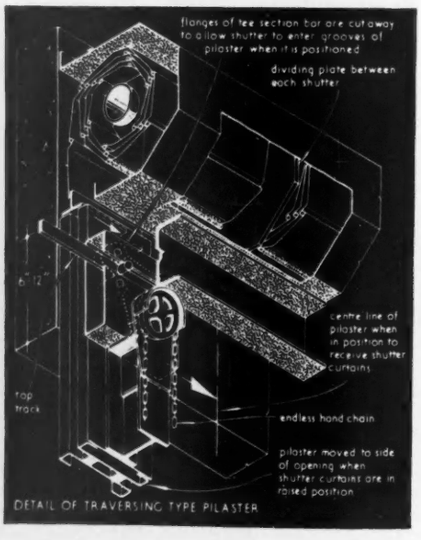


Haskins Electrically operated ROLADOR Steel Rolling Shutters installed for the Liquor Control Board of Ontario, New Warehouse, Ottawa, Canada. Traversing type pilasters separate three independently operated shutters.
Architects: Messrs. Balharrie, Helmer & Morin, Ottawa. General Contractors: Thomas Fuller Construction Co. Ltd., Ottawa.


flanges of tee section bar are cut away to allow shutter to enter grooves of pilaster when it is positioned
dividing plate between each shutter
centre line of pilaster when in position to receive shutter curtains
top track
endless hand chain
pilaster moved to side of opening when shutter curtains are in raised position
DETAIL OF TRAVERSING TYPE PILASTER

Haskins *ROLLING SHUTTERS & GRILLES*

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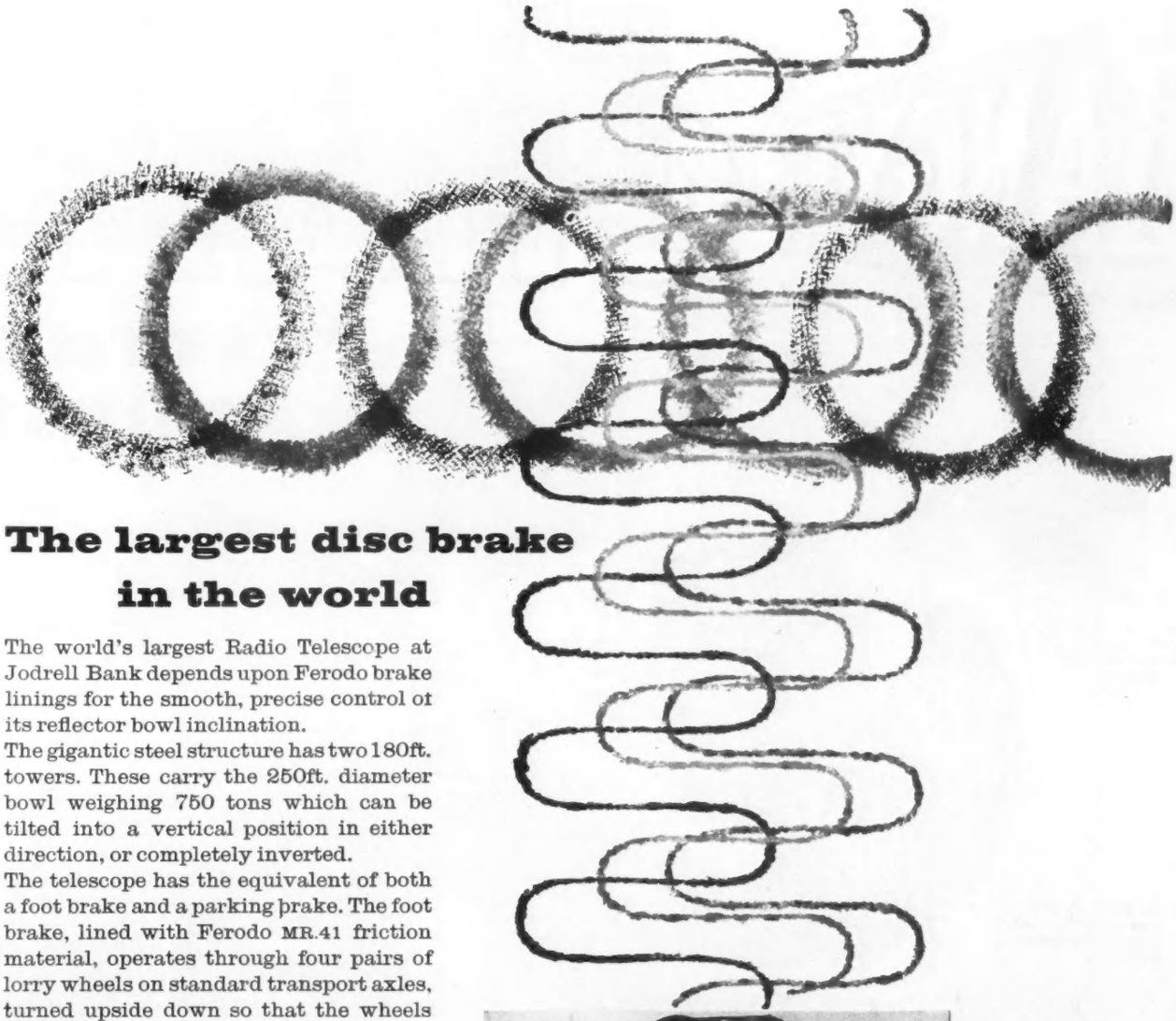
STEEL ROLLING SHUTTERS
WITH TRAVERSING TYPE PILASTERS

Traversing type pilasters can be moved to side of opening when Shutter curtains are in the raised position. This allows either a section or the whole unbroken width of the opening to be worked as required.
This is but one of the many ways by which Haskins Shutters provide security to any opening of any width and of any height.

Full details of Haskins Steel Shutters and illustrated catalogue on request.



The largest disc brake in the world

The world's largest Radio Telescope at Jodrell Bank depends upon Ferodo brake linings for the smooth, precise control of its reflector bowl inclination.

The gigantic steel structure has two 180ft. towers. These carry the 250ft. diameter bowl weighing 750 tons which can be tilted into a vertical position in either direction, or completely inverted.

The telescope has the equivalent of both a foot brake and a parking brake. The foot brake, lined with Ferodo MR.41 friction material, operates through four pairs of lorry wheels on standard transport axles, turned upside down so that the wheels press against the 300ft. diameter 'bicycle wheel' stabilising track fixed behind the reflector bowl.

The parking brake is the largest disc brake in the world, designed to hold the massive revolving bowl firmly in position even in gale-force winds. It consists of two jack-operated clamps mounted in tandem and lined with 32" x 6" strips of Ferodo BA material.

Ferodo friction materials have been proved in industry to give the smoothest, safest stopping power. *If you have a friction problem*—as the designers of the Jodrell Bank Radio Telescope had—why not call in Ferodo?

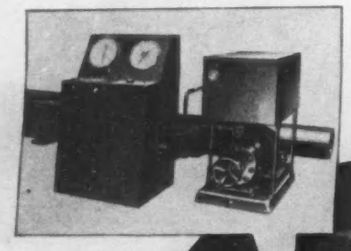
FERODO

friction materials for industry

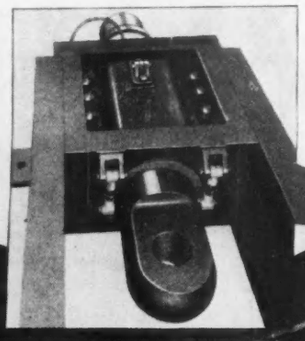
FERODO LIMITED · CHAPEL-EN-LE-FRITH *A Member of the Turner and Newall Organisation*

8/46

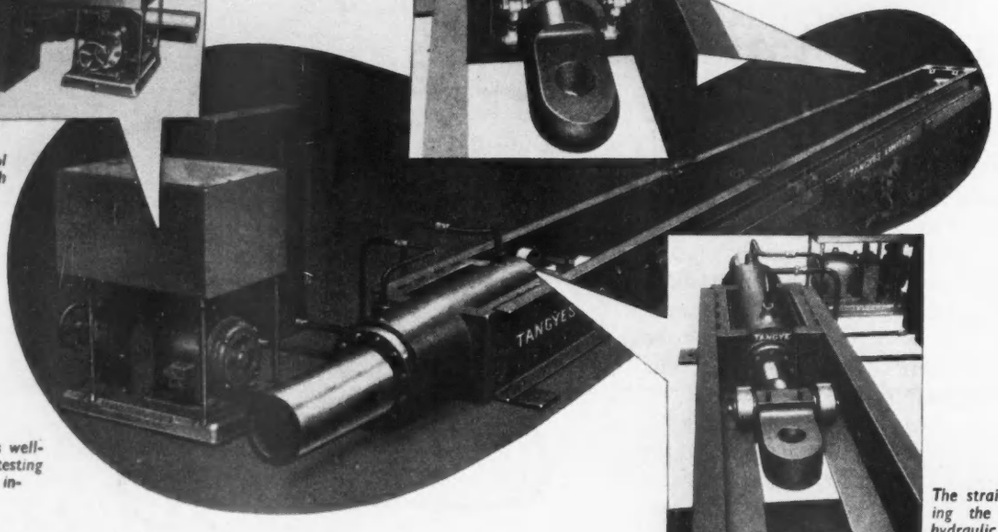
TANGYE CHAIN TESTING MACHINES



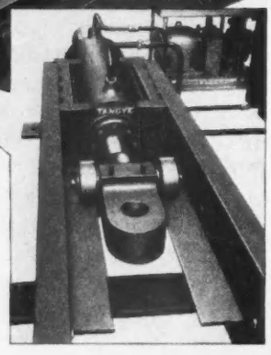
View from operating position showing control Cabinet and pump with oil reservoir.



The resistance head showing linkage support to eliminate friction. Hydraulic capsule and capillary tube also show.



A Tangye 100 tons well-type chain testing machine recently installed.

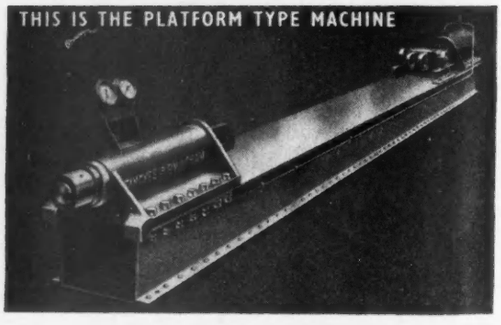


The straining end showing the double acting hydraulic cylinder and roller supports for the ram and tension rod.

This range of machines is for testing chains, shackles, complete lifting blocks, large rings and similar gear. One of the many features of these machines is the use of a tension rod which is suspended on links to take its weight and the weight of the specimen, thus preventing the rod contacting the bore and constituting a resistance. The pull being applied during a test is registered by a sensitive load capsule located on the tension rod, the capsule in turn being connected via capillary tubing to a dial-type load indicator.

Two types of machine are supplied, 'Platform' or 'Well' types, and these can be arranged for almost any working load, stroke or length. Examples of dimensions and capacities of machines now in use, are shown in the table.

FULL INFORMATION IS AVAILABLE ON REQUEST



EXAMPLES OF CAPACITIES OF MACHINES NOW IN USE SHOWN BELOW

	Platform Type				Well Type			
Working Load. *In Tons*	50	75	75		15	30	50	100
Stroke of Straining End Piston. *In Inches* ..	36	36	36		30	30	30	36
Centres of Eye Ends on Tension Rods	30′	34′	16′		20′ 6″	30′ 6″	25′ 9″	51′

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and in the BEST BOX
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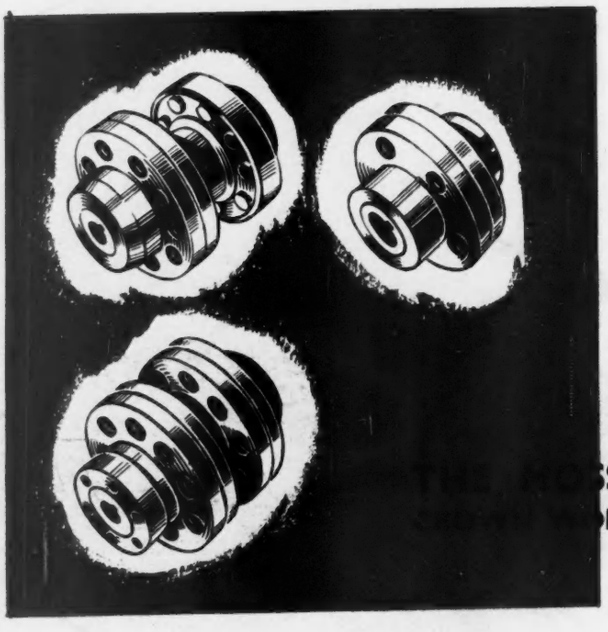

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